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**D E C I S I O N**  
of 15 February 1995

**Case Number:** T 0324/92 - 3.3.3

**Application Number:** 84308220.7

**Publication Number:** 0143643

**IPC:** C08B 31/00

**Language of the proceedings:** EN

**Title of invention:**  
Production of a cross-bonded starch

**Patentee:**  
CPC INTERNATIONAL INC.

**Opponent:**  
National Starch and Chemical Corporation

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56, 84, 123(2)(3)

**Keyword:**  
"Amended claims - based on original disclosure; not broadened  
in scope; sufficiently precise"  
"Novelty (affirmed) - no implicit disclosure"  
"Inventive step (affirmed) - no "one way street""

**Decisions cited:**  
T 0012/81; T 0860/93

**Catchword:**  
-



Case Number: T 0324/92 - 3.3.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.3  
of 15 February 1995

**Appellant:**  
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**Respondent:**  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office dated 7 November  
1991 and issued in writing on 5 February 1992  
concerning maintenance of European patent  
No. 0 143 643 in amended form.

**Composition of the Board:**

**Chairman:** C. Gérardin  
**Members:** R. Young  
W. Schar

## Summary of Facts and Submissions

I. The grant of European patent No. 0 143 643, with seven claims and relating to the production of a cross-bonded starch, in respect of European patent application No. 84 308 220.7, filed on 27 November 1984 and claiming a priority of 28 November 1983 (GB 8 331 712) was announced on 13 January 1988 (cf. Bulletin 88/02).

II. Notice of Opposition was filed on 5 October 1988 on the grounds of lack of novelty and inventive step. The opposition was supported inter alia by the documents:

D2: US-A-4 207 355, and the later filed, but admitted

D5: Die Stärke, Vol. 32, (1980), No. 3, pages 83 to 90, considered in the form of its English translation.

III. By an interlocutory decision which was given at the end of Oral Proceedings held on 7 November 1991 and issued in writing on 5 February 1992, the Opposition Division found that the patent could be maintained in amended form on the basis of Claims 1 to 7 of the second auxiliary request filed on 7 November 1991, Claim 1 of which reads:

"A process for cross-bonding starch by reacting the starch with a mixture of acetic anhydride and adipic acid in which prior to the reaction, the starch is treated for a few minutes with at least 0.03% hydrogen peroxide based on the dry starch weight."

Claims 2 to 7, which are directed to further embodiments of the process of Claim 1, correspond to the granted version of these claims.

It was held that the technical problem arising from the closest state of the art document D2, which disclosed the pre-treatment of starch with hydrogen peroxide prior to cross-linking, was that of increasing the extent of adipic-acetic anhydride cross-linking of starch without increasing the amount of cross-linking agent employed. This problem had been solved by two further features not disclosed in D2, namely (a) the limitation of the hydrogen peroxide pre-treatment to a few minutes, and (b) the use of at least 0.03% of hydrogen peroxide based on dry starch. There was no hint of this solution in D5, which was simply concerned with removing traces of sulphur dioxide from starch, nor even of a possible link between hydrogen peroxide treatment and cross-linking efficiency in any of the other cited documents. Consequently, the solution to the problem could not be said to be obvious.

IV. On 10 April 1992, a Notice of Appeal against the above decision was filed by the Appellant (Opponent), together with payment of the prescribed fee.

In the Statement of Grounds of Appeal filed on 15 June 1992 and subsequent written submissions, the Appellant argued in substance as follows:-

- (i) It was clear from D5 that a starch slurry as produced in the wet milling process could contain much greater concentrations of sulphur dioxide - up to 1000 ppm - than the 40 ppm previously assumed, and in such a case the skilled person would have had no choice but to add a greater amount of hydrogen peroxide; there was thus a "one-way street" in which any effects on stability would be thrown into his lap without inventive

activity (Statement of Grounds of Appeal, pages 3, 4 and submission filed on 10 March 1993). An affidavit by Daniel B. Solarek concerning the residual amounts of sulphur dioxide was filed with the Statement of Grounds of Appeal.

- (ii) In any case, an improvement in stability would have been expected from removing residual sulphur dioxide, since this was known to react with carbonyl compounds and would therefore have interfered with the crosslinking action of the acetic anhydride and adipic anhydride (Statement of Grounds of Appeal, pages 4, 5).
- (iii) Although the desirable effect referred to in the patent in suit was that the stability of the viscosity of starch sols to shear, heat and acid should be maintained, the examples showed that the starch samples which had been cross-linked without a hydrogen peroxide pretreatment had a more constant, i.e. stable, viscosity than those pretreated with hydrogen peroxide. Consequently, there was no improvement (submission filed on 17 December 1993, pages 1 to 3).

In the course of the proceedings, the Appellant relied on five further documents for the first time, of which the following played a role in the proceedings:

- D7: "Die Stärke", Vol. 24, 1972, No. 10, pages 348 to 353 (see Statement of Grounds of Appeal, page 5);
- D10: "Die Stärke", Vol. 25, (1973), No. 10, page 344;  
and
- D11: Letter of 16 January 1984 from the Corn Refiners Association to the Hearing Officer of the Food and Drug Administration (see submission filed on 10 March 1993, pages 2 to 4).

V. The Respondent (Patentee) objected to the introduction of the letter (D11) and argued substantially as follows:

- (i) The high quantities of hydrogen peroxide quoted by the Appellant were not typical of industrial starch slurries; on the contrary, a careful reading of D5 showed that the elevated levels of sulphur dioxide had been deliberately achieved for the sake of the experiments only. The relevant slurry, i.e. that exiting the hydrocyclone stage of the refining process, would have had a residual quantity of sulphur dioxide of around 80 ppm (cf. submission filed on 3 November 1992, pages 1 to 3);
- (ii) The effect of the claimed measures was not restricted to that arising from the elimination of residual sulphur dioxide, since it was obtained even on the basis of the measured amount of adipyl cross-linking groups, as could be seen from Example 3 of the patent in suit (submission filed on 14 June 1993, pages 1, 2).
- (iii) The technical problem was thus how to increase the cross-bonding effect of a given amount of adipyl groups in a modified starch molecule; the solution of subjecting the starch, prior to cross-linking, to a pretreatment with hydrogen peroxide was not taught or suggested by any of the cited prior art (submission filed on 14 June 1993, page 2, last para.).

VI. Oral proceedings were held before the Board on 15 February 1995. At the oral proceedings, the Appellant raised a new ground of opposition, namely that of Article 100(c) EPC, as well as an objection under

Article 84 EPC against Claim 1. In particular, the Appellant made the following points:

- (i) Article 123(2) EPC had been contravened because there was no basis in the application as originally filed for the presentation, in Claim 1, of an upwardly open range of the amount of hydrogen peroxide used.
- (ii) Article 123(3) EPC had been contravened because the amendments introduced during the opposition proceedings, although at first sight rendering Claim 1 narrower in scope, in fact broadened it when viewed in the light of the doctrine of equivalents applied in infringement proceedings before certain national courts. A tabular presentation of arguments was filed in support of this.
- (iii) The phrase "for a few minutes" in Claim 1 was not clear as required by Article 84 EPC.

VII. The Appellant requests that the decision under appeal be set aside and the patent be revoked in its entirety. As an auxiliary request, referral of the following question of Law to the Enlarged Board of Appeal is requested:

"Should national law be considered in the application of Article 123(3) EPC?"

The Respondent requests that the appeal be dismissed.

## Reasons for the Decision

1. The appeal is admissible.

2. *Late filed documents*

2.1 The documents D7 and D10, referred to above, although filed well outside the nine month opposition period, are generally available documents of a factual nature to provide corroborative support for arguments which have already formed part of the proceedings, and are therefore, in spite of their lateness, admitted to the proceedings.

2.2 The document D11 is, however, of a different nature. Quite apart from being dated after the priority date of the patent in suit, the statements it makes are vague and not supported by concrete evidence. It amounts therefore to an unsupported allegation by one party. It is therefore disregarded in accordance with Article 114(2) EPC.

3. *Allowability of Amendments; clarity.*

Claim 1 differs from the version as filed and granted in two respects, namely the addition of the two features (a) and (b), referred to in section III, last paragraph, above.

The source of support for these amendments as well as the finding that they limit the protection conferred is given in the relevant section of the decision under appeal (see Reasons for the decision, para. 4).



3.1 The Appellant's argument that there was no basis for an open ended range starting at 0.03% hydrogen peroxide is not convincing because it fails to take account of the disclosure, in the application as filed, of a range of the preferred amount of hydrogen peroxide used ("preferably up to 0.45% based on the dry starch weight, more preferably 0.03 to 0.3%"), together with the absence, from both description and claims, of any absolute upper limit (cf. page 3, lines 3 to 5 of the application as filed; page 2, lines 36 to 37 of the patent as granted, and Claim 1 as filed and granted). Reading the document as a whole, therefore, an open range was disclosed.

The amendment, the effect of which is to disclaim the part of this range below the disclosed preferred lower limit of 0.03%, is therefore not open to objection under Article 123(2) EPC.

3.2 The Appellant's argument, in relation to Article 123(3) EPC, that there is subject-matter which would infringe Claim 1 as amended to include features (a) and (b), but would not have infringed Claim 1 as granted is not supported by any convincing evidence. On the contrary, the tabular presentation filed at the oral proceedings merely presents features of D2 and a variant as a possible infringement.

Although the question of determining the extent of protection for infringement purposes is dealt with according to Article 64(3) EPC by national law and thus does not fall within the competence of the Board, clearly from a logical point of view, if the use of a variant forming an alleged equivalent of, say, the subject matter of D2 were held to fall under Claim 1

having the limitations (a) and (b), it would also necessarily fall under the claim without these limitations, i.e. in the form as granted.

Consequently, even applying such an "infringement test" as put forward by the Appellant, there is no reason for concluding that Claim 1 has been broadened by amendment. On the contrary, the Board fully concurs with the finding of the decision under appeal in this respect.

- 3.3 Since this finding is not altered even by taking into account the aspect of national law referred to by the Appellant, therefore, it follows that no important point of law in the sense of Article 112(1) EPC arises as far as the present proceedings are concerned.

Hence there is no justification for putting a question in this connection to the Enlarged Board of Appeal.

- 3.4 The Appellant's objections under Article 84 EPC to the phrase "for a few minutes" were twofold: firstly, that someone wishing in the future to carry out such a pretreatment for, say, 30 minutes would not know whether this infringed the claim or not; and secondly, that the phrase "a few minutes" - in any case imprecise - could equally be interpreted as meaning the first few minutes of a pretreatment lasting several hours, such as was known from the prior art (D2).

- 3.4.1 The question of whether a hypothetical future act would infringe a claim depends on the extent of protection conferred. As pointed out above, however, the determination of such an issue does not lie within the competence of the Board.

In contrast to this, the question of whether the requirements of Article 84 EPC are met is determined when the claim is read by the person of normal skills including any knowledge derived from the state of the art. Furthermore, save in the case of a claim which is self-contradictory, it should be construed in its context in the light of the description (cf. the decision T 0860/93, OJ EPO 1995, 047).

- 3.4.2 Although it is true that the phrase "a few minutes" does not specify with mathematical precision the number of minutes, it is evident from the description that the reason for this limitation is that "The reaction...takes place very rapidly in a matter of a few minutes" (patent in suit, page 2, lines 39 to 40).

Thus the time feature, taken in its context, is defined, without any element of contradiction, from two different and complementary aspects: duration and function. The significance for the skilled person is therefore that the precise number of minutes is not relevant for the achievement of the essential technical effect.

- 3.4.3 Furthermore, the relevant state of the art (D2), from which, according to the decision under appeal, a distinction was sought by means of the limitation "a few minutes", discloses a pretreatment having a duration of 16 hours (cf. reasons for the decision, para. 8).

Thus, for the subject-matter for which protection is sought to be clear in the sense of Article 84 EPC, the skilled person would only have reliably to be able to distinguish between the "few minutes" necessary for completion of the pretreatment reaction in the patent in suit and the several hours taught in relation to the

pretreatment disclosed in the relevant prior art. The difference between a few minutes and a few hours is, however, on average, a factor of sixty.

In the Board's view, the person of normal skill would have no difficulty in recognizing a difference of this magnitude.

3.4.4 As to the question of whether the feature "for a few minutes" could be interpreted as meaning the first few minutes of a treatment lasting several hours, it must be remarked that the Appellant's view, expressed at the oral proceedings before the Board, is in direct contradiction with the view apparently expressed by the same party at the oral proceedings held before the Opposition Division, where it was conceded that this particular feature established novelty over D2 (cf decision under appeal, Reasons, paragraph 8, first sentence). Notwithstanding this, such an extensive interpretation would assume that the phrase had effectively the same meaning as "for at least a few minutes". This is, however, to ignore the form of words actually used, the natural and ordinary meaning of which is perfectly understandable.

The extensive interpretation also fails to take account of the progressive nature of the pretreatment (cf. section 3.4.2, above). Any extension of the treatment beyond the period specified in the claim would therefore evidently be completely redundant for achieving effect of the process.

There is no justification, in the Board's view, for imposing such an extensive interpretation, which includes an evidently non-functioning aspect, especially

where, as here, this would necessitate a departure from the natural and ordinary meaning of the words used in the claim.

3.5 In summary, the use of the phrase "for a few minutes" in Claim 1 is, in the present context, sufficiently precise to meet the requirements of Article 84 EPC.

3.6 Since no other amendment apart from an adaptation of the description to the amended claims has been carried out, there is no further objection to the amendments.

4. *The closest state of the art; the technical problem*

The patent in suit is concerned with the production of cross-bonded starch by reaction of starch with adipic acid and acetic anhydride to provide acetylated di-starch adipate which may be used as a thickener in food compositions (cf. Claim 1; page 2, lines 3 to 7).

Such a method for cross-linking starch is, however, known from the document D2, which is considered to represent the closest state of the art.

4.1 According to D2, a cold-water dispersible modified starch, which forms a strong gel in cold water, i.e. without cooking and without setting salts, is obtained by drum-drying a tapioca starch which has been converted to a specified water fluidity, and then treating it with a crosslinking agent. It is suited for use in pie and cream fillings, puddings, spreads, jellies and instant mixes of the type which are reconstituted with water or milk and allowed to set at room temperature. A food system containing such a starch will have properties which closely resemble those of a food formulation which is cooked (cf. col. 1, line 67 to col. 2, line 46; Claim 1).

The starch is first converted to its fluidity form using a suitable method of degradation, such as mild acid hydrolysis with, e.g., sulphuric or hydrochloric acid, conversion with hydrogen peroxide, or enzyme conversion. In a preferred embodiment, the starch is acid-converted (col. 2, lines 50 to 66).

The converted starch having the desired water fluidity level is then reacted with any crosslinking agent capable of forming linkages between the starch molecules. Typical crosslinking agents are epichlorohydrin, linear dicarboxylic acid anhydrides, acrolein, phosphorus oxychloride, soluble metaphosphates, formaldehyde, cyanuric chloride, diisocyanates, and divinyl sulphone. Preferred are phosphorus oxychloride, epichlorohydrin, sodium trimetaphosphate and adipic-acetic anhydride (1:4). Most preferred is phosphorus oxychloride (col. 2, line 67 to col. 3, line 13).

According to Example IV.c, a starch sample which has first been converted to a water fluidity of 25 by treatment with sulphuric acid for 16 h (cf. Ex II) is slurried in water and adjusted to pH 8 with sodium hydroxide solution. To this, "mixed anhydride" (prepared by heating a mixture of one part adipic acid and four parts acetic anhydride) is added slowly, the pH being controlled at 8 with sodium hydroxide, the product being a strong gel (Table III).

- 4.2 A specified range of cross-linking, determined by measurement of the viscosity characteristics depends, other things being equal, on the amount of cross-linking agent which actually reacts with the starch (col. 3, lines 43 to 56). The latter amount is, however, strictly controlled by food regulations (cf. patent in suit, page 2, lines 11 to 13).

4.3 Compared with the closest state of the art, the technical problem is how to increase the cross-bonding effect, in terms of improved retention of viscosity properties under conditions of heat, acid and/or shear encountered in processing or application of food compositions comprising starch, of a given amount of adipyl groups in a modified starch molecule.

The solution proposed according to Claim 1 of the patent in suit is to treat starch, whereby the choice of starch is no longer restricted to tapioca starch, prior to the cross-bonding reaction, for a few minutes with at least 0.03% hydrogen peroxide based on the dry starch.

4.4 It is clear from the information given in connection with the examples of the patent in suit that the shear stability, acid stability and heat stability of cross-bonded starch products pre-treated with hydrogen peroxide according to the patent in suit are higher, for a similar level of cross-linking, than those for the products which have not been so pre-treated (cf. Examples 1 and 2).

4.5 The argument of the Appellant, that ratios of final to initial viscosities (before and after the tests under conditions of acid, heat or shear) in excess of unity meant that no improvement was achieved is in the Board's view of no substantial significance, since no evidence was offered which would call into question the physical existence of the reported lower loss of performance through the stress tests.

4.6 Although the Respondent's explanation of the identity of the denominator in the viscosity ratio was disputed by the Appellant, the Board has no reason to doubt that the ratios are a measure of the extent of retention of viscosity properties of a treated starch after being

subjected to acid, heat or shear stresses according to the relevant test. It is therefore reasonable to assume, in accordance with the corresponding statements in the patent in suit, that an increased ratio corresponds in fact to an improved performance in these terms (cf. page 3, lines 34 to 56).

- 4.7 It is in any case without question that the results of Example 3 demonstrate essentially the same viscosity behaviour for a pretreated modified starch having only 512 ppm adipyl groups as for a non-pretreated modified starch already having 1993 ppm adipyl groups (cf. page 3, lines 40 to 53). Consequently, it is evident that the cross-bonding effect of the adipyl groups has been increased by almost a factor of four by the hydrogen peroxide pretreatment.

In summary, therefore, it is plausible that the proposed measures are effective to solve the stated problem.

5. *Novelty*

Although recognising novelty in respect of features (a) and (b) of Claim 1, the decision under appeal found that D2 disclosed the pretreatment of starch with H<sub>2</sub>O<sub>2</sub> prior to cross-linking with adipic-acetic mixed anhydride, since H<sub>2</sub>O<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub> were presented in D2, at column 2, lines 58 to 64, as equivalents, so that H<sub>2</sub>O<sub>2</sub> could equally well have been used for the pretreatment in Example IV.c (cf. Reasons for the decision, para. 6, 7).

The Board is, however, unable to concur with the latter part of the finding.

- 5.1 In particular, the Board is unable to trace any basis for the assertion of equivalency in the presentation of the three pretreatments in the cited passage. On the



contrary, the passage merely refers to a "suitable method of degradation". Furthermore, the sentence immediately following refers to a starch which has been "acid-converted" as a preferred embodiment in order to adjust water fluidity (cf. col. 2, lines 64 to 66). Consequently, far from having any reason for considering that the acid pretreatment could "equally well" be carried out using hydrogen peroxide, the skilled reader would have been aware that the acid pretreatment was preferred.

- 5.2 Quite apart from this, the context of the cited paragraph does not associate the pretreatments listed directly with any specific example of D2, let alone Example IV.c. On the contrary, it is evident from the paragraph following the cited one that the pretreated or "converted" starch is reacted in a second step with "any cross-linking agent capable of forming linkages between the starch molecules". There then follows a list of several different cross-linking agents, of which the most preferred is in any case not adipic-acetic anhydride (col. 2, line 67 to col. 3, line 13).

Consequently, there are two independent lists of treatment agents: one for the pretreatment step and one for the cross-linking step. To arrive at the claimed combination, it would be necessary to select a specific pair of treatment agents from the two general lists. Such a selection, however, involves a new element (cf. also e.g. T 0012/81, OJ EPO 1982, 296).

- 5.3 In this connection, the argument of the Appellant, expressed at the oral proceedings, that the skilled person, having substituted the 16 hour H<sub>2</sub>SO<sub>4</sub> pretreatment of Example IV.c by an "equivalent" pretreatment with

H<sub>2</sub>O<sub>2</sub>, would then have perceived that less time was necessary and consequently have carried it out for only "a few minutes" is not convincing.

Not only is the premise of equivalency on which this argument is based not valid, for the reasons given above, but there is no evidence that the acid pretreatment reaction, the purpose of which is to degrade the starch to a certain level of fluidity, would take significantly less time if H<sub>2</sub>O<sub>2</sub> were used instead of H<sub>2</sub>SO<sub>4</sub>.

5.4 It is therefore not justified to conclude that D2 discloses, directly and unambiguously, the pretreatment of starch with H<sub>2</sub>O<sub>2</sub> prior to cross-linking with adipic-acetic anhydride.

5.5 Notwithstanding the above, the presence of the features (a) and (b) in any event confers novelty over the disclosure of D2, in view of the interpretation in section 3.4.4, above and for the same reasons as given in the decision under appeal (cf. Reasons for the decision, para. 10).

Thus the subject-matter of Claim 1 is considered to be novel over the disclosure of D2.

5.6 According to D5, the results of an investigation into ways of reducing the content of sulphur dioxide (the use of which is irreplaceable in the steeping of corn in industrial corn starch production), far below the permissible limit of 50 ppm in the final product, show that chemical methods are superior to physical methods. The residual amount, in starch products, of sulphur dioxide, which reacts as a Lewis acid with compounds containing free electron pairs, such as carbonyl compounds and amines, is mostly in the range of 0 to

40 ppm. It is possible to wash out sulphur dioxide from starch to residual levels below 10 ppm sulphur dioxide by adding chlorine, ammonia, sodium hydroxide or hydrogen peroxide (page 2, first para.; page 4, last para.; page 9, last para.; page 16, "Conclusions", first para.).

Although preliminary experiments with hydrogen peroxide were carried out with separator starch with a deliberately increased sulphur dioxide level (e.g. 1100 ppm), the subsequent investigations were preferably carried out with moist starch, because the reduction of the sulphur dioxide level in the industrial process should logically be inserted between the refining steps and dehydration. It was possible to reduce the sulphur dioxide level from 90 to 57 ppm by adding 47%, to 25 ppm by adding 76%, and to 0 within the error margin by adding 110%, i.e. a slight excess, of the stoichiometrically necessary amount of hydrogen peroxide (page 15).

Novelty is established in the subject-matter of Claim 1 over the disclosure of D5, since the latter does not refer to the cross-linking of starch.

5.7 Consequently, the subject-matter of Claim 1 is held to be novel.

6. *Inventive step*

To determine the issue of inventive step, it must be asked whether the skilled person, starting from D2, would have expected that the cross-bonding effect of a given amount of adipyl groups in a modified tapioca starch molecule, in terms of extent of retention of viscosity under the conditions of heat, acid and/or shear encountered in the processing and application of

food compositions, would be increased by treating any starch, prior to the cross-bonding reaction, for a few minutes with at least 0.03% hydrogen peroxide based on the dry starch.

6.1 Whilst the proposed use of the modified starches according to D2 in pie fillings or jelly formulations implies some resistance to acid, there is no hint as to the properties of the modified starches under conditions of heat and shear. On the contrary, the entire purpose of the process of D2 is to reproduce the properties of a cooked food system in a system which does not require cooking (cf. section 4.1, above).

Consequently, a skilled person interested in improving the stability of modified starch systems under the relevant stresses of heat and shear would not have recognised a useful starting point in the disclosure of D2.

6.2 Even if the skilled person were to have considered modifying the starch products disclosed in D2 with a view to improving the cross-bonding effect in the sense of the stated problem, there is no hint of any particular importance of the hydrogen peroxide pretreatment in this context. On the contrary, this pretreatment is neither the preferred embodiment in D2, nor even taught specifically for use with the adipic-acetic anhydride cross-bonding agent (cf. section 5 etc., "Novelty", above).

Much less is there any indication that, if used, it could be adjusted to have a duration of only a few minutes. Indeed, there is no reason to curtail such a pretreatment at all, let alone to the extent required by the solution of the stated problem, since this would be inconsistent with a principle aim of the process of D2 (cf. section 5.3, second para., above)

Hence, there is no hint to the solution of the stated problem in D2.

- 6.3 The teaching of D5 is even less concerned with the technical problem, since it is merely a report of a laboratory investigation into ways of neutralizing residual sulphur dioxide in a starch refining process.

There is no mention at all of cross-linking starch, let alone the effect of cross-linking with adipyl groups.

Consequently, there is no hint in the direction of the stated problem or its solution in D5.

- 6.4 Thus, the state of the art documents cited in the proceedings do not have sufficient relevance to assist the skilled person to recognise the stated problem, let alone its solution.

- 6.5 The burden of the Appellant's arguments is rather, however, that irrespective of any consideration relating to the technical problem, the skilled person, in carrying out a conventional starch refining process and then producing a cross-bonded starch, would necessarily be involved in carrying out the hydrogen peroxide pretreatment forming the solution of the stated problem. In particular, it is argued to be obvious to add larger quantities of hydrogen peroxide to neutralise residual sulphur dioxide in the refining of a starch slurry.

- 6.5.1 The point where it would be logical to add hydrogen peroxide in a starch refining process is, according to D5, between the refining steps and dehydration, i.e. after the hydrocyclone (cf. section 5.6, above).
- 6.5.2 According to the document D7, cited by the Appellant and referred to in the affidavit by Solarek, furthermore, the differences in the sulphur dioxide content of starch products before the hydrocyclone cannot be observed any longer after refining (i.e. after the hydrocyclone). A comparison of the sulphur dioxide contents in starch suspensions after the hydrocyclone from three separate industrial facilities shows values of 82.2, 83.7 and 79.9 ppm respectively (cf. page 348, summary, and page 350, Table 2).
- 6.5.3 A similar conclusion is reached according to the document D10, also cited by the Appellant, in which the average values for the sulphur dioxide content after the hydrocyclone are, on average, 89.3 ppm or 78.2 ppm depending on whether the processing is with or without sulphur dioxide addition (left col., first complete para.).
- 6.5.4 Although the affidavit of Solarek creates a different impression insofar as it states that "a typical starch slurry as is used in industry prior to starch derivation will contain larger amounts of SO<sub>2</sub>, in the order of from 300 to 500 ppm", the phrase "prior to starch derivation" is, on closer examination, ambiguous, since it does not designate precisely which such prior stage is meant, i.e. before or after the hydrocyclone.

- 6.5.5 Consequently, there is no support for the argument that industrially processed starch at the relevant point in the refining sequence would be expected to contain substantially more than the approximately 80 ppm of sulphur dioxide already admitted by the Respondent.
- 6.5.6 Moreover, it is clear from the teaching of D5 that the maximum amount of  $H_2O_2$  which would be necessary to assure complete removal of such residual sulphur dioxide is 110% of the stoichiometric amount for its neutralisation. Clearly, therefore, there would be no reason for the skilled person to contemplate adding quantities of  $H_2O_2$  anywhere approaching the amount of 300 pm (0.03%)  $H_2O_2$  required as a minimum by the solution of the technical problem.
- 6.5.7 As to the addition of  $H_2O_2$  for other purposes, such as to reduce bacterial "spoilage", no evidence was adduced to show that this would take place prior to a cross-bonding step.
- 6.5.8 Hence, there is no "one way street" by which the skilled person carrying out a conventional starch refining process would be forced in any case to add amounts of  $H_2O_2$  within the range claimed in the patent in suit.
- 6.6 The argument of the Appellant at the oral proceedings, that Claim 1 was not limited to the point of addition taught in D5 is irrelevant, because it does not alter the fact that no other point of addition of  $H_2O_2$  has been demonstrated to exist in the prior art.
- 6.7 The argument of the Appellant that any improvement of cross-bonding effect would have been expected because of the removal of residual sulphur dioxide which behaved as a Lewis acid with carbonyl compounds (cf. section IV. (ii), above) is unconvincing in view of the known

efficient conversion of sulphur dioxide, in water, to a bisulphite, which, however, according to the uncontested submission of the Respondent at the oral proceedings, has not been shown to be reactive at all with adipic acid.

The argument is in any case irrelevant in view of the results of Example 3 of the patent in suit, which show an improved cross-bonding effect in terms of the adipyl groups actually present, i.e. independent of any residual sulphur dioxide.

6.8 The Appellant's argument at the oral proceedings, that the Respondent has failed to show that no improved effect is obtained with  $H_2SO_4$  instead of  $H_2O_2$  is also irrelevant, since the onus is on the Appellant at this stage to demonstrate that the relevant effect is obtainable elsewhere in the cited art.

6.9 In summary, there is no hint in the state of the art that would have enabled the skilled person to reach the solution of the technical problem. Nor is there any reason for supposing that the skilled person, in carrying out a conventional starch refinement process would be involved in reaching such a solution.

In other words, the subject-matter of Claim 1 does not arise in an obvious way from the state of the art. It therefore involves an inventive step in the sense of Article 56 EPC.

7. By the same token Claims 2 to 7, which are directly or indirectly dependent on Claim 1 are also directed to subject-matter which involves an inventive step.



Order

For these reasons it is decided that:

1. The request by the Appellant to refer a question of law to the Enlarged Board of Appeal is refused.
2. The appeal is dismissed.

The Registrar:

  
E. Görgmaier

The Chairman:

  
C. Gérardin