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**Datasheet for the decision
of 3 May 2019**

Case Number: T 1901/16 - 3.3.05

Application Number: 03798172.7

Publication Number: 1546035

IPC: B01J29/04, C07D301/12,
C07D303/04, C01B15/037,
C01B15/013, B01J29/89,
C01B15/023

Language of the proceedings: EN

Title of invention:

NOVEL AQUEOUS HYDROGEN PEROXIDE SOLUTIONS

Patent Proprietor:

Evonik Degussa GmbH

Opponents:

THE DOW CHEMICAL COMPANY
Solvay (Société Anonyme)
BASF SE

Headword:

Novel aqueous hydrogen peroxide solution/Evonik Degussa

Relevant legal provisions:

EPC Art. 54(1), 54(2), 56, 84, 123(2), 111(1), 111(2)

EPC R. 103(1)(a)

RPBA Art. 12(4), 13(1), 13(3)

Keyword:

Novelty - main request (no) - auxiliary request 2 (yes)

Inventive step - unexpected improvement shown

inventive step - auxiliary request 2 (yes)

Claims - clarity after amendment (yes)

Amendments - allowable (no)

Appeal decision - remittal to the department of first instance (no)

Reimbursement of appeal fee - (no) - competence of department of first instance

Late-filed facts - submitted with the statement of grounds of appeal

Late-filed argument - admitted (no)

Decisions cited:

T 0608/12, T 0308/14, T 1115/10

Catchword:



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Case Number: T 1901/16 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 3 May 2019

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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted on
13 June 2016 concerning maintenance of the
European Patent No. 1546035 in amended form.

Composition of the Board:

Chairman E. Bendl
Members: T. Burkhardt
P. Guntz

Summary of Facts and Submissions

- I. The appeal of the patent proprietor (appellant 1) and of the three opponents (appellants 2, 3 and 4) lies from the opposition division's interlocutory decision to maintain European patent EP 1 546 035 in amended form on the basis of the then first auxiliary request.
- II. Following the first appeal in the present case, T 608/12, in which the board had come to the conclusion that the patent in suit fulfilled the requirements of Article 83 EPC, the opposition division held that the grounds of opposition mentioned in Article 100(a) in conjunction with Article 54 (1) and (2) EPC prejudiced the maintenance of the patent as granted but that the patent as amended in the form of the then first auxiliary request fulfilled the requirements of the EPC.
- III. In the proceedings before the opposition division the following documents were among those discussed:
- | | |
|----|--|
| D2 | F Bellinger <i>et al.</i> , "Corrosion and Stability Studies", Industrial and Chemical Engineering, 38(3), 1946, 310-320 |
| D3 | WO 00/76989 A2 |
| D4 | US 5,200,166 A |
| D8 | "Hydrogen Peroxide", Ullmann's Encyclopedia of Industrial Chemistry, A 13, Fifth Edition, VCH, 1989, pp. 443-466 |
- IV. With their grounds of appeal, the appellants submitted, among others, the following documents and supplementary results:

- D41 WO 99/54254 A1
- D41a ASTM D5127-98 Standard Guide for Ultra Pure Water Used in the Electronics and Semiconductor Industry, 1998
- D42 US 3,126,257 A
- D44 "Water. 7. Feed Water, Boiler Water and Steam", Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH, 2016, pp. 1-10
- D45 US 3,372,990 A
- D46 US 2,871,102 A
- D47 Solvay Interlox Ltd., "Environmental Data sheet, 35% HYDROGEN PEROXIDE (SPECIFICATION ST-35%)", 2001
- D48 Solvay Interlox Ltd., "ENVIRONMENTAL DATA, 35% HYDROGEN PEROXIDE TECHNICAL GRADE (SPECIFICATION 111)", 2001

- D51 First experimental results by opponent 1
- D52 First experimental results by opponent 2
- D53 First experimental results by opponent 3

V. The appellants filed inter alia corrections to their experimental results:

- D51b Second experimental results by opponent 1
- D52a Second experimental results by opponent 2
- D53a Second experimental results by opponent 3

VI. In the course of the appeal procedure, the patent proprietor also submitted, in addition to the current main request (claims as granted), auxiliary requests 1-6.

VII. Independent claim 1 of the main request (patent as granted) reads as follows:

"1. An aqueous hydrogen peroxide solution comprising:
i) less than 50 wppm alkali metals, alkaline earth metals or combinations thereof in total, irrespective whether the alkali or alkaline earth metals are present in cationic or complex form;
ii) less than 50 wppm of amines having a pK_B of less than 4.5 or the corresponding protonated compounds in total; and
iii) at least 100 wppm anions or compounds that can dissociate to form anions in total, whereby the wppm are based on the weight of hydrogen peroxide."

VIII. Claim 1 of the auxiliary request 1 differs from claim 1 of the main request in the nature of the anion compounds iii) :

"iii) at least 100 wppm anions selected from oxophosphorous anions and nitrate or compounds that can dissociate to form these anions in total".

IX. Claim 1 of auxiliary request 2 differs from claim 1 of the main request in the amount of the anion compounds iii) , which has to be in the range of:

"iii) ~~at least~~ from 100 wppm to 1,000 wppm anions or compounds that can dissociate to form anions in total".

The remaining independent claims of this request read as follows:

"9. A process for the preparation of the hydrogen peroxide solution of any of claims 1-8 according to the anthraquinone loop process comprising:

- a) hydrogenation of a working solution comprising an organic solvent or mixture of organic solvents and one or more active anthraquinone compounds,
- b) oxidation of the hydrogenated working solution to form hydrogen peroxide,
- c) extraction of hydrogen peroxide with water,
- d) stabilizing of the extracted aqueous hydrogen peroxide solution,
- e) concentrating the aqueous hydrogen peroxide solution to a concentration of hydrogen peroxide of at least 50% by weight based on the weight of the hydrogen peroxide solution,
- f) drying of the working solution after extraction, and
- g) regeneration and purification of the working solution,

whereby during the entire process neither alkali or alkaline earth metals nor amines having a pK_B of less than 4.5 or compounds forming such amines during the process are introduced in amounts that result in amounts of

- i) 50 wppm or more of alkali metals, alkaline earth metals or combination thereof in total, irrespective whether the alkali or alkaline earth metals are present in cationic or complex form; or
- ii) 50 wppm or more of amines having a pK_B of less than 4.5 or the corresponding protonated compounds in total;

in the resulting aqueous hydrogen peroxide solution, whereby the wppm are based on the weight of hydrogen peroxide."

"16. Use of the aqueous hydrogen peroxide solution of any of claims 1-8 or of the aqueous hydrogen peroxide solution obtainable by the process of any of claims 9-15 for the epoxidation of olefins."

Claims 2 to 8, 10 to 15 and 17 to 18 relate to preferred embodiments.

- X. The arguments of the patent proprietor, as far as relevant for the present decision, may be summarised as follows:

The opposition division decided against the *ratio decidendi* of T 608/12 when considering that water and hydrogen peroxide were compounds as per feature iii) of claim 1. This amounted to a severe procedural violation which justified the refund of the appeal fee.

The documents and experimental results submitted by the opponents during the appeal procedure should not be admitted.

The inventive-step objection, based on D42, against the subject-matter of claim 1 of auxiliary request 2 should not be considered since it was only raised during the second oral proceedings at the appeal stage.

The subject-matter as defined by the claims of the main and the auxiliary requests fulfilled the requirements of the EPC.

- XI. The arguments of the opponents, as far as relevant for the present decision, may be summarised as follows:

Auxiliary requests 1-6 should not be admitted as they were filed late and unsubstantiated.

The main request (claims as granted) did not fulfil the requirements of Articles 54 and 56 EPC. The first

auxiliary request (claims as upheld) contravened Articles 123(2) and (3), 54 and 56 EPC, and the second auxiliary request did not comply with Articles 84, 54 and 56 EPC.

The inventive-step objections, which were raised in the written appeal procedure against higher ranking requests only, should be considered against lower ranking requests as well.

XII. The final requests of the parties are as follows:

The patent proprietor requests that the decision under appeal be set aside and that the patent be maintained as granted or, in the alternative, that the appeals of the opponents be dismissed (auxiliary request 1), or that the patent be maintained in amended form on the basis of one of auxiliary requests 2 to 6 as submitted with the submissions dated 9 March 2017 (auxiliary requests 2, 3 and 5), 26 February 2018 (auxiliary request 6) and 3 April 2019 (auxiliary request 4), respectively. It further requests that the appeal fee be reimbursed.

The opponents request that the decision under appeal be set aside, the new documents and supplementary reports be admitted, and that the case be remitted to the department of first instance for further prosecution or, by way of an auxiliary request, that the patent be revoked in its entirety.

Reasons for the Decision

1. Reimbursement of the appeal fee and remittal
 - 1.1 In the proprietor's view, the opposition division decided in a technically incorrect manner against the *ratio decidendi* of the first decision in the present case, T 608/12, when considering that water and hydrogen peroxide were compounds as per feature iii) of claim 1. This would amount to a severe procedural violation.
 - 1.2 In T 608/12, the board had held that the requirements of Article 83 EPC were met. The opposition division construed claim 1 such that both water and hydrogen peroxide were compounds falling under the definition of the anion compounds in feature iii) of claim 1 of the contested patent (see point 23.7 of the contested decision).
 - 1.3 However, when doing so, the opposition division construed feature iii) of claim 1 in a technically incorrect way. While features in the claims should indeed be given their broadest technically sensible meaning, claim 1 only makes sense if neither water nor hydrogen peroxide fall under feature iii) of claim 1:
 - Claim 1 requires an aqueous hydrogen peroxide solution fulfilling requirements i) , ii) and iii) . The total amount of the anion compound iii) has to exceed 100 wppm on a hydrogen peroxide basis. However, if hydrogen peroxide was a compound falling under iii) , its amount would be based on itself, which is illogical.

- Moreover, the total amount of anion compound iii) would then by far exceed 100 weight percent (and not 100 wppm) since the amount of hydrogen peroxide divided by itself already yields 1 corresponding to 100%. Water would have to be added as well. In other words, the lower limit of 100 wppm, and nothing remotely close, could not be obtained.

- Finally, an amount of water in the ppm range makes no sense for an aqueous solution.

Consequently, the technical claim interpretation by the opposition division was incorrect. Claim 1 is to be construed so that neither water nor hydrogen peroxide are accounted for when determining the amount of the components according to feature iii) of claim 1.

- 1.4 In the patent proprietor's view, the opposition division decided against the *ratio decidendi* of T 608/12. In reason 1.6 of that decision, it is indicated "that the claimed compositions can be prepared without undue burden simply by mixing the necessary amounts of i), ii) and iii) as defined in claims 1 and 9 with an aqueous solution which would be substantially free of alkali- and alkaline earth metal ions and of amines having a pK_B of less than 4.5". In other words, when preparing the solution in this way, the anion compounds as per iii) were *different* from the "aqueous solution".
- 1.5 The patent proprietor also referred to T 308/14 in which the board held that the opposition division decided against the *ratio decidendi* of the previous decision T 1115/10 in the same case when coming to the conclusion that the requirements of Article 83 EPC were not met.

In T 1115/10, it had been decided that the parameter "weight average molecular weight" complied with Article 84 EPC. This had thus become *res judicata* according to T 308/14. It consequently went against the *ratio decidendi* of that decision to raise an objection under Article 83 EPC on the basis that this very feature was ambiguous ("insufficiency arising out of ambiguity").

1.6 However, T 308/14 does not apply to the present case. While it was ruled in T 308/14 that a parameter cannot comply with Article 84 EPC and, at the same time, cause an insufficiency objection under Article 83 EPC because the same parameter is ambiguous, T 608/12 in the present case *merely indicates one way of carrying out the invention* when evaluating compliance with Article 83 EPC. It does not give an exhaustive analysis of how compound iii) in claim 1 should be construed. Reason 1.6 states that "the claimed compositions *can be* prepared without undue burden simply by mixing the necessary amounts of i), ii) and iii)" and not "*have to be prepared*" or "*must be prepared*". Moreover, nowhere in the decision is it stated that water and hydrogen peroxide must not be considered when determining the amount of compound iii) .

1.7 In conclusion, the opposition construed claim 1 in a technically incorrect way but did not decide against the *ratio decidendi* of T 608/12.

Hence the proprietor's request for a reimbursement of the appeal fee under Rule 103(1) (a) is rejected.

1.8 As the present appeal is already the second one in this case and for reasons of expediency and procedural economy, the board exercises its discretion under

Article 111(1) EPC not to remit the case to the department of first instance for further prosecution.

2. Consideration of new documents, supplementary experimental results and facts
- 2.1 The patent proprietor requests that all the documents and experimental results submitted at the appeal stage not be admitted as they were filed late and are not relevant.
- 2.1.1 With regard to the cited documents, the proprietor holds that the possibility of a different claim construction, in which neither water nor hydrogen peroxide are compounds as per feature iii) of claim 1, was already mentioned in the summons dated 7 August 2015 to the second oral proceedings in opposition and could not justify a submission of new documents at the appeal stage.

However, all these documents were already submitted with the grounds of appeal (Article 12(2) RPBA).

Furthermore, documents D41 and D42 are highly relevant since they relate to hydrogen peroxide solutions either produced by direct synthesis or by means of an anthraquinone process without a urea-type solvent. This limits the risk of the presence of undesired amines.

Although not having indicated this earlier, the opposition division eventually acknowledged a positive effect on the selectivity of the epoxidation catalyst at elevated running times after a reduction of the amines having a pK_B of less than 4.5 in the oral proceedings (point 26.6, page 15, of the contested decision).

The submission of D41 and D42 by the opponents is therefore considered a legitimate response to the arguments in the contested decision.

Documents D41a and D44 correspond to common general knowledge relating to the presence of impurities in purified water. Their submission aims at further corroborating that the H₂O₂ solutions of the prior art only contain limited amounts of alkaline (earth) metals and amines having a pK_B of less than 4.5.

Consequently, the board does not exercise its discretion to not admit these documents under Article 12(4) RPBA.

- 2.1.2 On the other hand, D45 is not relevant since the hydrogen peroxide solution of the example cannot be considered as *aqueous* only because of the addition of small amounts of aqueous solutions to an otherwise organic solution.

No attention was paid in D46 to the purity of the water (e.g. in Example II) and possible contaminations with alkali (earth) metals or amines having a pK_B of less than 4.5.

D47 and D48 are data sheets of H₂O₂ solutions commercialised by opponent 2 itself. The board cannot see any reasons why these documents were not filed in the first-instance proceedings.

For these reasons, the board exercises its discretion under Article 12(4) RPBA and does not admit these documents.

2.1.3 The opponents filed experimental results D51, D52 and D53 with their grounds of appeal and in order to prove the absence of a technical effect.

The proprietor holds that the experimental results should have already been filed in the first-instance proceedings. More especially, the proprietor holds that opponent 3's tests, which relate to the impact of the addition of amines having a low pK_B with different epoxidation catalysts, correspond to a new argument and thus to a "fresh case".

The opponents had already indicated in their notices of *opposition* and in one of opponent 2's letters that the various parameters in claim 1 had no technical effect. Since, however, the opposition division, in the contested decision, acknowledged for the first time a positive effect related to the amine content, the supplementary tests are considered a legitimate response to the arguments in the contested decision.

According to the proprietor, it was moreover not plausible that the first series of experiments of the opponents took only four months, i.e. between the issuance of the contested decision in June 2016 and the submission of the grounds of appeal in October 2016, whereas the - less exhaustive - additional tests took as long as eight months according to opponent 3's letter dated 14 December 2017 (page 2). This would prove that the first series of experiments was not a reaction to the contested decision but that they had been started before the oral proceedings in opposition.

However, the opponents actually had six months to submit the first supplementary results between the oral proceedings in April 2016 and the submission of the

grounds of appeal in October 2016. It is hence not implausible that the opponents started the experiments only after the announcement of the decision.

Thus, there is no proof of an abuse of procedure, and the board sees no reason to exercise its discretion to not admit the results of the first series of the supplementary experiments by the opponents under Article 12(4) RPBA.

- 2.2 According to Article 13(1) RPBA, amendments may be admitted at a later stage at the board's discretion.

With regard to the second series of experimental results D51b, D52a and D53a, the board is satisfied that their submission is a reaction to the proprietor's comment, that the concentrations of phosphate, nitrate and sodium on a H_2O_2 basis do not change when an aqueous hydrogen peroxide solution is further concentrated.

The board consequently exercises its discretion and admits these experiments.

- 2.3 According to Articles 13(1) and (3) RPBA, amendments made after the arrangement of oral proceedings are only exceptionally admitted.

During the oral proceedings, the proprietor alleged that the supplementary experimental results submitted by the opponents were not relevant since the continuous addition of a very small quantity of amines (see page 2 in D53) would result in an extremely low amine flow rate (about two drops per day), which could not be reliably controlled. Moreover, the use of pressure vessels (also page 2 of D53) would imply pressures

significantly below the pressure of 27 bar of Example 2 of the contested patent.

However, especially since these allegations were made for the first time during the oral proceedings and since the experimental results of the patent in suit were reliably reproduced (see D51b No. 0-2017, D52a, Trial 1' and D53a VI.1), the proprietor's allegation is not convincing, and the board decides to not admit this new line of argument.

3. Main request: Novelty

The claims of the main request are identical to those as granted.

3.1 For the following reasons, the subject-matter of claim 1 is anticipated by D41 (Article 54(1) and (2) EPC).

D41 discloses a method for the direct synthesis of hydrogen peroxide from hydrogen and oxygen. The resulting aqueous hydrogen peroxide solution is to be used in the electronics and semiconductor industry (page 1, lines 3 to 10, and page 4, lines 29 to 36).

According to Example 2, phosphate is present in the resulting aqueous H₂O₂ solution in an amount of 11236 ppm on a H₂O₂ basis (= 1000 ppm/8,9wt%).

The total organic carbon content of the solution is less than 10 ppb, which excludes the presence of 50 wppm (or more) of amines having a pK_B of less than 4.5 or the corresponding protonated compounds.

According to Example 2, ultra pure water ("Hochreines Wasser") is used. Table 1 of D41a indicates that such ultra pure water used in the electronics and semiconductor industry has an alkali (earth) metal content of at most less than 2 wppm, even for the least pure type E-4 (Table 1).

- 3.2 The patent proprietor holds that an alkaline (earth) metal content of less than 50 wppm on a H₂O₂ basis is not directly and unambiguously disclosed in D41, especially since, according to Example 1, the sodium compound Na₂PdCl₄ is used for the preparation of the catalyst for the H₂O₂ synthesis and since Example 3 would moreover show the presence of metal ions in the sump of the evaporator. Finally, the washing step with sodium hydroxide in Example 3 would show that the sodium content is not critical in D41.

These arguments are not convincing. According to Example 1, the catalyst is subsequently washed with highly pure water ("Reinstwasser"), thus inevitably removing any traces of sodium.

Metal ions are admittedly detected in the sump of the subsequent evaporator in Example 3 but the sump is the result of a recycling of the liquid ("Flüssigkeitsumlauf") until an almost complete evaporation of the liquid ("nahezu vollständige Verdampfung"). This means that components appear in the sump only as a consequence of an important accumulative effect.

Finally, the washing step with NaOH occurs only subsequently to Example 2 and there is no hint to a potential sodium source in the process steps before; quite the contrary since ultra pure water is used during the hydrogen peroxide production.

The alkali (earth) metal content in the hydrogen peroxide solution is hence beyond reasonable doubt less than 50 wppm.

4. Auxiliary request 1: Amendments

4.1 In view of Article 123(2) EPC not being complied with (see below), there is no need to discuss the admissibility of this request.

4.2 For the following reasons, claim 1 of auxiliary request 1 does not fulfil the requirements of Article 123(2) EPC.

The newly introduced feature "... anions selected from oxophosphorous anions and nitrate ..." is allegedly based on page 11, lines 6 to 9, as originally filed. However, the same paragraph specifies that these anions, if present, are there in the "usual stabilizing amounts" (lines 5 to 6). In other words, the presence of these anions in the aqueous H₂O₂ solution in amounts *different* from the usual stabilising amounts is now encompassed by claim 1 but was not disclosed in the documents as originally filed.

4.3 The proprietor also considers page 9, lines 4 to 11, as originally filed as a possible basis for the new feature. Yet while this passage does not comprise limits for the stabilising anions, it merely refers to "phosphate" and not to the more general "oxophosphorous anions" of claim 1. Consequently, this passage is not a valid basis for the amendment either.

5. Auxiliary request 2

5.1 Auxiliary request 2: Admissibility

Opponent 2 requests that auxiliary request 2 not be admitted because it was filed late, diverging and not substantiated. For the following reasons, this view is not convincing, and the board exercises its discretion under Article 12(4) RPBA to admit this request:

- Firstly, auxiliary request 2 was filed with the reply to the opponents' grounds of appeal but it had already been submitted during the first-instance proceedings, namely as the second auxiliary request filed with the submission of 21 March 2016.

- The request is a legitimate reaction to the board's preliminary view that neither water nor hydrogen peroxide may be considered anion compounds as per feature iii) of claim 1, this view being contrary to that of the contested decision.

- Finally, auxiliary request 2 may also be considered a reaction to the submission of D42 with the opponents' grounds of appeal. As will be explained under point 5.3.2 below, D42 discloses in Example 1 a content of phosphorous anions above 100 wppm (H₂O₂ basis) but not unambiguously below the newly introduced limit of 1000 wppm.

5.2 Auxiliary request 2: Clarity

Opponent 3 alleges that the introduction of the upper limit of 1000 wppm on a H₂O₂ basis for the anion compound iii) causes a clarity issue under Article 84

EPC since this upper limit would always be exceeded due to the presence of water and H₂O₂.

This argument is not convincing. As explained under point 1.3, neither water nor hydrogen peroxide are to be accounted for when determining the amount of the anion compounds iii) . Consequently, the introduction of the upper limit of 1000 wppm does not introduce a clarity issue.

5.3 Auxiliary request 2: Novelty

For the following reasons, the subject-matter of the claims of auxiliary request 2 is novel within the meaning of Article 54(1) and (2) EPC.

- 5.3.1 Document D4 discloses in Example 6 an aqueous hydrogen peroxide solution which is based on the "high purity hydrogen peroxide solution a" in the table bridging columns 4 and 5. To this solution, either nitric or orthophosphoric acid have been added. In the first-instance proceedings, opponent 2 submitted calculations to show that the added amounts correspond to 179.2 wppm nitric acid and 556.5 wppm orthophosphoric acid on a H₂O₂ basis, thus falling within the claimed range for component iii) (see Annex 1 of the minutes of the oral proceedings held on 21 April 2016).

The "high purity hydrogen peroxide solution a" is likely to be produced by the anthraquinone process (column 1, lines 25 to 29) and the total organic carbon content TOC amounts to 22.2 ppm on a H₂O₂ basis (= 7 ppm/ 31.5%). A portion of 0.6 ppm thereof (= (0.5ppm-0.3ppm)/31.5%) corresponds to aminotris(methylene-phosphonic acid) AMPTP (see the

foot notes of the table bridging columns 4 and 5), which has a pK_B of less than 4.5, as argued by the proprietor. This was not contested by the opponents.

Even the opponents admitted that the limit of 50 wppm on a H_2O_2 basis would be exceeded if the TOC of 7 ppm in D4 *exclusively* originated in methyl amine. However, they pointed to the fact that such a situation was not realistic and that it was sufficient for lack of novelty that a feature be disclosed beyond reasonable doubt in a prior art document.

However, the remaining 6.8 ppm (absolute) of the TOC in solution "a" could originate entirely from an amine having a pK_B of less than 4.5, such as methyl amine, AMTP or nitrilotriacetic acid. The latter is mentioned in D4 as a possible decomposition inhibitor (column 3, line 39) and, depending on the chemical nature of the solvent used in the anthraquinone process, amine impurities with a pK_B of less than 4.5, such as monoalkyl amine, can be formed, especially when a tetraalkyl urea is used (see paragraph [5] of the contested patent or D8 page 447 right-hand column "Solvents").

Another possible source of amines having a pK_B of less than 4.5 is the use of strong anion exchange resins for purifying the H_2O_2 solution in D4 (see column 2, lines 22 to 44, and claim 1). For example, D44 (page 2, column 2) indicates that ion exchangers with quaternary ammonium groups are commonly used to demineralise water. However, in such an event, at least some of the ammonium groups might be released and present in the purified water. Since D4 is silent on the negative effect of amines having a pK_B of less than 4.5 on the performance of an epoxidation catalyst (D4 rather deals

with H₂O₂ solutions for the electronics industry) and since the opponents have not proven that this effect was known, the skilled person would not have paid attention to this phenomenon.

In this case, for methyl amine, AMTP or nitrilotriacetic acid, the concentration corresponding to the TOC would exceed 50 wppm on a H₂O₂ basis, and thus criterion ii) in claim 1 would not be fulfilled.

In other words, feature ii) of claim 1 is not directly and unambiguously derivable from D4.

- 5.3.2 For the following reasons, the subject-matter of claim 1 is novel vis-à-vis D42 (Article 54 (1) and (2) EPC).

D42 discloses in Example 1 an aqueous hydrogen peroxide solution resulting from the hydrogenation of an anthraquinone compound, an oxidation step and an extraction step in which water freed from mineral ingredients is used. According to opponent 1's and 2's grounds of appeal, anion compounds as per criterion iii) of claim 1 are present in an amount of at least 112 wppm on an absolute basis, corresponding to an addition of orthophosphoric acid to arrive at a pH of 3. This calculated amount was not disputed by the patent proprietor.

Due to the fact that the hydrogen peroxide concentration in the aqueous solution of Example 1 of D42 is certainly lower than 100% on an absolute basis, the amount of anion compounds is inevitably higher than 112 wppm on a H₂O₂ basis, possibly even higher than the upper limit of the claimed range of 1000 wppm on a H₂O₂ basis.

In its grounds of appeal (see page 8), opponent 3 submitted calculations to show that the anion content in Example 1 of D42 is of 320 wppm on a H₂O₂ basis. However, these calculations are based on the assumptions that the conversion into hydrogen peroxide is at its theoretical maximum and that the absolute amount of working solution is 10 litres. However, both assumptions are questionable. The conversion is certainly lower than the theoretical maximum, and Example 1 indicates a *flow rate* of the working solution of 10 l/h and not a *quantity* of 10 l.

Moreover, the presence of amines having a pK_B of less than 4.5 in an amount of more than 50 wppm on a H₂O₂ basis cannot be excluded. D42 indeed indicates that ion exchangers may possibly be used to remove the mineral ingredients from the water that is used in the process (column 2, line 72, to column 3, line 4). D44 (page 2, column 2), for example, indicates that ion exchangers with quaternary ammonium groups can be used to demineralise water. In such an event, at least some of the ammonium groups may be released into the purified water.

The opponents argue that the capacity of the anion exchange resin would decrease if ammonium groups were released and that the skilled person would not have used this type of anion exchangers under these circumstances. This argument is not convincing. Since D42 is silent on the negative effect of amines having a pK_B of less than 4.5 on the performance of an epoxidation catalyst (the use of the H₂O₂ solution for the production of epoxides is not even mentioned in D42), the skilled person would not have paid special attention to this phenomenon. Hence the release of

ammonium groups into the demineralised water of D42 cannot be excluded.

Therefore, it is at least not directly and unambiguously derivable from D42 that criteria ii) and iii) of claim 1 are fulfilled.

5.3.3 For the same reasons, the subject-matter of the other claims of auxiliary request 2 is also novel within the meaning of Article 54 (1) and (2) EPC.

5.4 Auxiliary request 2: Inventive step

For the following reasons, the subject-matter of the claims of auxiliary request 2 involves an inventive step within the meaning of Article 56 EPC.

5.4.1 Invention

The invention relates to an aqueous hydrogen peroxide solution, its preparation and use (paragraph [0001] of the patent).

5.4.2 Closest prior art

In a first line of attack, the opponents considered D3 as closest prior art.

D3 deals with the preparation of an aqueous hydrogen peroxide solution and a process for reacting an organic compound with this solution (see the claims). For instance, olefins are catalytically reacted with the hydrogen peroxide solution to obtain epoxides. An

objective is to increase the selectivity of the catalyst (see the paragraph bridging pages 3 and 4).

The board is satisfied that D3 relates to the same technical field and has numerous features in common with the subject-matter of claim 1. D3 is thus a reasonable starting point for assessing inventive step.

5.4.3 Problem to be solved

The technical problem to be solved vis-à-vis D3 is to provide a hydrogen peroxide solution suitable for improved long-term activity of the epoxidation catalyst (see paragraph [20] of the patent in suit).

5.4.4 Solution

As a solution to the posed problem, an aqueous hydrogen peroxide solution according to claim 1 is proposed, characterised in a content of amines having a pK_B of less than 4.5 less than 50 wppm.

5.4.5 Success of the solution

A comparison between Example C2 of the contested patent (Table 1) and Trial N° 3' of the supplementary experimental results D52a of opponent 2 (see the upper table on page 2) shows that, for an elevated catalyst running time of above 1100 h, a content of methyl amine of less than 50 wppm on a H_2O_2 basis has a beneficial effect on the hydrogen peroxide conversion as compared to a test with 100 wppm of methyl amine on a H_2O_2 basis (columns "CH2O2" and "H2O2 conv.", respectively). The conversion increases from 22% to 60%, in spite of the running time of the test without amine being even some 200 h higher.

As shown in Table 2 of the contested patent, methyl amine has a pK_B of less than 4.5.

The opponents confirmed that their supplementary results were representative. This is confirmed by Trial N° 1' of D52a, which is a reproduction of Example 2 of the contested patent and which yields substantially identical results with regard to hydrogen peroxide conversion (column "H2O2 conv.") and hydrogen peroxide selectivity towards propylene oxide (column "PO selectivity").

Opponent 1 argues that the effect cannot be acknowledged over the entire range since Example 2-2017 of D51b would not show a decrease of the hydrogen peroxide conversion after an addition of dibutylamine DBA above the claimed range. It is noted that DBA is an amine with a pK_B of less than 4.5 according to Table 2 of the contested patent.

This argument is not persuasive since the running time in Example 2-2017 of D51b of slightly above 700 h is significantly lower than those of both Example C2 of the contested patent and of Trial 3' of D52a with more than 1100 h. Yet, according to the proprietor, the detrimental effect of the amines with a low pK_B are only visible at elevated running times and, in the absence of counter-evidence, this is acknowledged.

Moreover, Example 2 of D51b *further* differs in the absence of ammonia (in Example C2 of the contested patent, 500 wppm NH_3 on a H_2O_2 basis were added). Since the opponents have not submitted experimental results with an addition of DBA, for a comparable elevated running time and with an addition of ammonia, there is

no evidence that the effect would not be present over the entire claimed range.

The opponents' argument, that the presence of NH_3 is an essential feature missing in claim 1, is not convincing either. The opponents have not refuted the proprietor's view that ammonia results in an increase of the selectivity but is not necessarily present in the aqueous hydrogen peroxide solution. They have not submitted proof that the beneficial effect related to a limited amount of amines with a low pK_B is not present in the absence of ammonia either.

Opponent 2 held that Trial N° 3' of D52a should be compared to Example C1 of the contested patent rather than C2. This view is not shared by the board. Example C1 differs from Trial N° 3' not only in the addition of DBA but also in a significantly higher running time. Using this comparison, it is hence not possible to isolate an effect related to the presence of amines having a low pK_B .

Opponent 2 notes that the elevated running time of the epoxidation catalyst does not appear in the claims. While this is true, the catalyst running time is not a structural property of the aqueous hydrogen peroxide solution and the board is satisfied that all the essential structural features of the aqueous hydrogen peroxide solution, which are necessary to achieve the effect, do figure in the independent claims 1.

The supplementary results provided by opponent 3, namely D53 and D53a, cannot render the effect implausible either, since these experiments were also carried out at relatively low running times, i.e. running times of below 700 h.

The board is hence satisfied that the problem is successfully solved.

5.4.6 Obviousness

The opponents have not pointed to evidence in the available prior art that shows the negative influence of amines having a pK_B of less than 4.5 on the catalytic epoxidation performance, and the board cannot see such an incentive either.

At the filing date, it would therefore not have been obvious for the skilled person, when starting from the aqueous hydrogen peroxide solution of D3, to limit the amount of amines with a pK_B of less than 4.5.

5.4.7 In further lines of attack, the opponents consider D4 and D42 as alternative closest prior art.

With regard to the new inventive-step attack based on D42 against claim 1 of auxiliary request 2, which was brought forward for the first time during the oral proceedings, the board notes the following. D42 was already used for a novelty objection against auxiliary request 2, and the new inventive-step attack may be considered as a reaction to the arguments concerning an effect related to the presence of only a limited amount of amines having a pK_B of less than 4.5 based on the comparison of Trial N° 3' of D52a and Example C2 of the patent in suit raised for the first time in the oral proceedings. Consequently, the board exercises its discretion under Rules 13(1) and 13(3) RPBA and admits this inventive-step attack.

Additionally, the subject-matter of independent claim 1 of auxiliary request 2 differs from both D4 and D42 - just as from D3 - at least in that the presence of amines having a pK_B of less than 4.5 is limited to 50 wppm (H₂O₂ basis) (see points 5.3.1 and 5.3.2).

Hence, the argumentation with regard to D3 also applies *mutatis mutandis* to D4 and D42, and the subject-matter of claim 1 is consequently inventive when starting from D4 or D42.

- 5.4.8 Opponent 1 additionally asserted that the second paragraph on page 22 of its letter dated 14 December 2017 referred to further inventive step attacks starting from other documents.

However, this passage has to be read in conjunction with the preceding paragraph which indicates D3 or D4 as the starting point for assessing inventive step.

In opponent 1's view, further inventive-step objections had also been brought forward with regard to the auxiliary request in the opponents' replies to the proprietor's grounds of appeal.

Yet these references still refer to the claims of the main request, not the auxiliary requests. Indeed, the latter had been submitted only a couple of days before and were not yet accounted for in the opponent's replies to the proprietor's grounds of appeal.

- 5.4.9 During the oral proceedings, opponent 2 stated that it wished to start from document D46 as an alternative closest prior art.

D46 had only been used by opponent 2 in its grounds of appeal to attack inventive step of the *main request*. It had never been used for an inventive-step attack against the second auxiliary request.

Finally, for the reasons given under point 2.1.2, this document is not considered.

- 5.4.10 Opponent 1 moreover held that the various inventive-step attacks raised in the grounds of appeal with regard to the main request should also be considered with respect to auxiliary request 2.

However, objections against the main or the first auxiliary request cannot be considered as automatically and implicitly applying to auxiliary request 2 as well. Their admission is subject to the board's discretion in accordance with Article 13 (1) and (3) RPBA.

Auxiliary request 2 is identical to auxiliary request 2 as filed one month before the first-instance oral proceedings. Following the proprietor's re-submission of this request at the appeal stage with the submission of 9 March 2017, there had consequently been ample opportunity for the opponents to react to this request in a timely manner. Yet no other inventive-step objections had been raised against auxiliary request 2 apart from those based on D3 and D4.

Under these circumstances, neither the proprietor nor the board could be reasonably expected to deal with further inventive-step attacks since this would have rendered necessary the assessment of different sets of distinguishing features, different technical problems to be solved and different reasons for obviousness.

Consequently, the board exercises its discretion under Article 13(1) and (3) RPBA to not consider a further inventive-step attack based on D46.

- 5.4.11 The subject-matter of claim 1 of the second auxiliary request therefore fulfils the requirements of Article 56 EPC.

- 5.4.12 For the same reasons, the subject-matter of the other claims of auxiliary request 2 is also inventive within the meaning of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of the second auxiliary request as submitted with the letter of 9 March 2017 together with a description and drawings to be adapted.
3. The request for reimbursement of the appeal fee is rejected.

The Registrar:

The Chairman:



C. Vodz

E. Bendl

Decision electronically authenticated