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Datasheet for the decision of 26 March 2010

Case Number:	T 0743/07 - 3.3.01
Application Number:	97109326.5
Publication Number:	0812836
IPC:	C07D 301/12
Language of the proceedings:	EN

Title of invention:
Process for producing epoxidized product of olefins

Patentee:
Sumitomo Chemical Company, Limited

Opponent:
Evonik Degussa GmbH

Headword:
Epoxidation process/SUMITOMO

Relevant legal provisions:
EPC Art. 54, 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Novelty (yes) - single step process not included"
"Inventive step (no) - obvious combination of steps"

Decisions cited:
-

Catchword:
-

Case Number: T 0743/07 - 3.3.01

DECISION
of the Technical Board of Appeal 3.3.01
of 26 March 2010

(Opponent)

Evonik Degussa GmbH
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Representative: -

Respondent:
(Patent Proprietor)

Sumitomo Chemical Company, Limited
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Representative:

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Decision under appeal:

Decision of the Opposition Division of the European Patent Office posted 2 April 2007 rejecting the opposition filed against European patent No. 0812836 pursuant to Article 102(2) EPC 1973.

Composition of the Board:

Chairman: P. Ranguis
Members: G. Seufert
C.-P. Brandt

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal against the decision of the Opposition Division dated 2 April 2007 rejecting the opposition against European patent No. 812 836, which was granted on the basis of 7 claims with independent claim 1 reading as follows:

"A process for producing an epoxidized product of olefins, which comprises (a) a preparation process of an alcohol medium solution of hydrogen peroxide produced by catalytically reacting hydrogen with oxygen in an alcohol single medium using a halogen compound of the platinum group metal without requiring formaldehyde and (b) an oxidation process of olefins using the resulting medium solution of hydrogen peroxide in the presence of an oxidizing catalyst."

II. Opposition was filed by the Appellant requesting revocation of the patent in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC).

III. The Opposition Division, referring *inter alia* to the following documents:

(1) WO-A-9602323
(2) M. G. Clerici et al., J. Cat., vol. 129, 1991, pages 159-167
(3) EP-A-49806
(5) Gmelins Handbuch der Anorganischen Chemie, 8th edition, system number 65, palladium, Verlag Chemie, Berlin 1942, pages 275, 278, 285,

held that the subject-matter of claim 1 of the patent in suit, clearly referring to a two-step process, was novel over the single-step process disclosed in document (1), and involved an inventive step, since the skilled person had no motivation to combine the teaching of document (2) with that of document (3).

IV. With the summons to oral proceedings, the Board sent a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), indicating the issues to be discussed. In this context, the Board indicated that document (1) might be relevant in the assessment of inventive step.

V. During oral proceedings before the Board, which took place on 26 March 2010, the Respondent defended the maintenance of the patent on the basis of the claims as granted as its sole request.

In the context of inventive step, documents (1) and (3) and the motivation of the skilled person to combine each of these documents with document (2) were discussed.

VI. The arguments of the Appellant, submitted in the written procedure and during oral proceedings, to the extent that they are relevant for this decision, can be summarised as follows:

The subject-matter of claim 1 of the patent in suit was not novel in view of examples 4 and 5 of document (1). These examples described a single-step process for the preparation of propylene oxide from propene, hydrogen and oxygen. The formation of hydrogen peroxide was evident from page 9, line 27 - page 10, line 9 of document (1). The reaction catalyst, which had been prepared by impregnating a titanosilicate using palladium chloride and ammonia, had only been partially reduced, and thus inevitably contained unreduced palladium(II) chloride or the corresponding complex. The wording of claim 1 of the patent in suit is such that for the skilled reader a process whereby the steps a) and b), i.e. the formation of hydrogen peroxide from hydrogen and oxygen and the oxidation of olefin using the hydrogen peroxide thus prepared, were carried out simultaneously was not excluded.

Document (2) represented the closest prior art. It described the oxidation of propene with hydrogen peroxide in aqueous methanol to the corresponding propylene oxide in high selectivity and without the formation of large amounts of by-products. The oxidation reaction did not require an aqueous high concentration solution of hydrogen peroxide, as was apparent from page 161, right column, last paragraph - page 162, left column, line 13, page 164, left column, last paragraph, and Table 1 of document (2). Considering the fact that the subjective problem as formulated in paragraph [0011] of the patent in suit, namely providing a process for the production of epoxidized product of olefins with high selectivity without requiring an aqueous high concentration hydrogen peroxide solution and without producing large amounts of by-products, was already solved by document (2), the objective problem to be solved was the provision of an alternative process. In view of the teaching of document (2) that methanol was the best oxidation medium, the skilled person would consider document (1), which belonged to the same field and which disclosed the preparation of a methanol solution of hydrogen peroxide. Neither the low concentration of the hydrogen peroxide methanol solution prepared according to example 3 of document (1) nor the results in examples 5 and 6 of that document, which merely taught the skilled person that in the single-step oxidation of document (1) in which olefin and hydrogen were simultaneously present the predominant reaction in methanol was the hydrogenation of propene to propane, would discourage the skilled person from using the methanol solution of hydrogen peroxide prepared according to document (1) in the oxidation step of document (2). Nor would the skilled person be deterred by the warning in document (2) about the instability of anhydrous or near-anhydrous organic solutions. Advantages concerning the complexity of the apparatus were not apparent in view of the fact that both the patent in suit and document (2) used the same apparatus, namely an autoclave.

VII. The arguments of the Respondent, submitted in the written procedure and during oral proceedings, to the extent that they are relevant for this decision can be summarised as follows:

The subject-matter of the patent in suit was novel over document (1) insofar as the presently claimed process required that the two steps a) and b) be carried out consecutively. This was apparent from the wording of the claim, which referred in step b) to the use of the resulting medium solution of hydrogen peroxide, and was confirmed by the description in paragraph [0021] of the patent in suit. A single-step process as disclosed in examples 4 and 5 of document (1) was not included in the claimed subject-matter.

Document (2) was considered to be the closest state of the art. In view of this document the problem to be solved was the provision of a process for producing an epoxidized product of olefins using an oxidant having high selectivity so as to obtain the desired product in high yield and without requiring an aqueous high concentration hydrogen peroxide. The skilled person had no reason to combine the teaching of document (2) with the teaching of document (1) in order to solve this problem. In the first place, document (2) did not disclose the use of an alcohol single medium of hydrogen peroxide in the oxidation reaction. In addition, a comparison of examples 5 and 6 of document (1) clearly taught the skilled person that the selectivity to propylene oxide was much higher in water than in methanol. Furthermore, document (2) always used high concentration solutions of hydrogen peroxide, as could be seen from a typical run of the oxidation reaction described on page 161 of document (2) or page 162, left column, last paragraph, while the concentration of the hydrogen peroxide in the methanol solution of example 3 of document (1) was significantly lower. It was not apparent either that the catalyst in example 3 of document (1) was a halogen compound of a platinum group as required in step a) of the patent in suit. Further reasons why the skilled person had no motivation to consider a combination of documents (1) and (2) were the facts that document (2) required a complex apparatus and additional dilution steps, that it was related to a process on a laboratory scale and the results could not easily be extrapolated to a process on an industrial scale, which was the ultimate goal of the patent in suit and, finally, that it would clearly deter the skilled person from using a methanol solution of hydrogen peroxide in view of the warning against the use of anhydrous or near-anhydrous organic solution of hydrogen peroxide.

VIII. The Appellant requested that the decision be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed.

IX. At the end of the oral proceedings the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

Sole request

2. *Novelty*

2.1 The Appellant has challenged novelty of the subject-matter of claim 1 of the patent in suit in view of the disclosure in document (1), particularly examples 4 and 5 of that document.

2.2 Document (1) describes the preparation of epoxides from olefins, hydrogen and oxygen using an oxidation catalyst on the basis of titanium or vanadium silicates containing specific platinum group metals, whereby these metals are present in at least two different bond energy states (document (1), claim 7). Examples 4 and 5 of document (1) disclose the single-step preparation of propylene oxide from propene, hydrogen and oxygen in the presence of an oxidation catalyst prepared according to examples 1 and 2 of document (1). The oxidation catalyst is suspended in butanol (example 4) or methanol (example 5) in a pressurized glass reactor and contacted for 30 minutes with hydrogen gas. Thereafter, a gaseous mixture of propene, hydrogen, oxygen and nitrogen is introduced. Chromatographic analysis shows the formation of mainly propane and small amounts of propylene oxide.

The oxidation catalyst in examples 4 and 5 of document (1) has been prepared by impregnating a titanium silicate with a Palladium(II)-tetraminochloro complex followed by partial reduction. In the finished catalyst, three bond energy states of the Pd-3d$_{5/2}$ photoelectrons were identified by means of X-ray photoelectron spectroscopy, which formally correspond to the oxidation states +2, +1 and 0.

2.3 According to the Appellant, claim 1 of the patent in suit encompasses a process for producing an epoxidized product of olefins whereby the processes a) and b) are performed simultaneously as disclosed in examples 4 and 5 of document (1). In its opinion, the wording of the claim merely indicates a causal correlation between both processes. It does not however imply that the processes a) and b) are necessarily separated in space and time. The Appellant argued that it is part of the general knowledge of the person skilled in the art that a process with two process steps can be run in such a way that both steps are carried out in the same apparatus and the same reaction medium. In this way, the solution of the intermediate in the reaction medium obtained in the first step can be used without isolation of the solution in the second step. The person skilled in the art would therefore understand claim 1 of the patent in suit in such a way as to include the single-step process of examples 4 and 5 of document (1). Furthermore, the Appellant argued that claim 1 of the contested patent as it stands is clear and that therefore there is no need for interpretation, and in particular there is no justification for a narrower interpretation of its meaning and scope. Such a narrow interpretation is also not in accordance with the description of the patent in suit. In support the Appellant referred to paragraph [0012] of the contested patent.

2.4 The Board is not convinced by the Appellant's arguments. Claim 1 of the disputed patent refers to the production of an epoxidized product of olefins comprising **two** processes: a) the catalytic reaction of hydrogen and oxygen in an alcoholic single-medium in the presence of a catalyst to form an alcohol single-medium solution of hydrogen peroxide and b) the oxidation of olefins in the presence of a catalyst using the resulting medium solution of hydrogen peroxide. In the understanding of the Board the wording of the claim, and in particular the wording "***using the <u>resulting</u> medium solution of hydrogen peroxide***", clearly refers to the use of the product, namely the hydrogen peroxide solution, obtained at the end, i.e. as the result, of the first process as one of the starting products in the second process. It does not describe a situation where both processes take place simultaneously and hydrogen peroxide, which may be formed in situ, immediately reacts with the available propene.

This understanding of the Board is also confirmed by the description of the contested patent. Nowhere in the description is there an indication that the consecutive running of steps a) and b), which is the way in which the skilled reader would normally understand the wording of the claim, is merely a preferred option. In paragraph [0021] it is explicitly mentioned that "In the present invention the alcohol medium solution of hydrogen peroxide **thus obtained** is used in an epoxidation reaction step of olefins as the **following** step". Thus, the skilled person, despite any general knowledge he may have as to how two-step processes could in theory be conducted, has no reason to interpret claim 1 of the contested patent differently from the way in which he would normally understand it. The Board cannot see either in what sense paragraph [0012] supports the Appellant's interpretation of claim 1, since the content of the cited paragraph is identical to the wording of claim 1 of the contested patent.

2.5 In view of the above, the Board concludes that in the process according to the present invention the processes a) and b) are at least separated in time. The subject-matter of claim 1 of the patent in suit is therefore not anticipated by the single-step process according to examples 4 and 5 of document (1) and meets the requirement of Article 54 EPC.

3. *Inventive step*

3.1 The patent in suit is directed to an epoxidation process in which olefins are oxidised using an alcohol medium solution of hydrogen peroxide which has been prepared by catalytic reaction of hydrogen and oxygen in an alcohol single-medium using a halogen compound of a platinum group metal. A preferred olefin to be oxidised is propene and a preferred oxidation catalyst is titanosilicate.

3.2 The oxidation of propene to its epoxide, i.e. propylene oxide, with hydrogen peroxide in an aqueous methanol medium in the presence of titanium silicate as oxidising catalyst has already been described in document (2). The hydrogen peroxide aqueous methanol medium solution used therein has typically been prepared by diluting a commercially available 60 wt% aqueous peroxide solution of hydrogen peroxide with water and methanol to obtain a hydrogen peroxide solution of about 30 wt% and further considerably diluting this solution with methanol in the oxidation process (page 161, right column, line 14 - page 162, left column, line 3).

The selectivity to propylene oxide is between 75% in a reaction medium with 25 wt% methanol and 97% in a reaction medium with 92 wt% methanol (document (2), page 163, Table 1).

Document (2) specifically indicates that methanol is the best reaction medium for the oxidation reaction of propene to propylene oxide, as the reagents and products are soluble therein, the reaction is fast and formaldehyde is produced only in negligible amounts. Aqueous methanol reaction medium solutions of hydrogen peroxide have merely been used for practical reasons (document (2), page 164, left column 6-12).

3.3 According to the Opposition Division as well as both parties, document (2) represents the closest state of the art. The Board sees no reason to depart from this finding and, hence, takes this document as the starting point for assessing inventive step.

3.4 In the light of document (2) the Respondent considered the problem to be solved by the present invention as the provision of a process for the production of an epoxidized product of olefins by using an oxidant having high selectivity so as to obtain the desired product in high yield and without requiring high concentration aqueous hydrogen peroxide solutions (see also page 3, lines 3-7 of the patent in suit).

3.5 The Board notes that propylene oxide is already obtained in high selectivity (75-97%) without producing a large amount of by-products in the catalytic oxidation process according to document (2) using the same oxidant, namely hydrogen peroxide (document (2), Table 1). In this respect, the claimed process with a selectivity of 70% and no information as to any improvements concerning the amount of by-products has no advantages over the process of document (2).

With regard to the assertion that the process in document (2) requires high concentration aqueous hydrogen peroxide solutions, it is first to be noted that the Board, in view of the description of the contested patent and the arguments provided by the Respondent, understood the unclear expression "**high concentration**" as referring to aqueous hydrogen peroxide solutions with 30 wt% or more hydrogen peroxide (page 2, paragraph [0005] of the patent in suit). The Board further notes that according to document (2) the oxidation process per se does not require a high concentration of hydrogen peroxide in the reaction medium. Document (2) explicitly mentions that the use of a concentrated solution of hydrogen peroxide is unnecessary and that the oxidation is fast even in dilute solutions. The hydrogen peroxide concentration can be as low as 1% (page 164, left column, last paragraph and Table 1). Even in dilute aqueous solutions (3 to 7 wt%) the oxidation proceeds, although at a low rate (page 164, left column, first whole paragraph, last six lines). It is furthermore apparent from Table 1 of document (2) that the reaction medium solutions in examples 10-13 with their low amount of methanol could easily be obtained by diluting an aqueous hydrogen peroxide solution with a significantly lower concentration than 60 wt% or 30-35 wt% hydrogen peroxide with methanol. The use of high concentration aqueous hydrogen peroxide solutions is therefore not a requirement of the oxidation process according to document (2). Their use was merely a convenient way to prepare without great effort a hydrogen peroxide reaction medium with a low content of water, which according to document (2) has certain advantages, from a commercially available hydrogen peroxide source.

Hence, in the light of document (2) the Board considers the problem to be solved by the present invention as the provision of an alternative process for the preparation of epoxidized products of olefin with high selectivity.

3.6 As the solution to this technical problem the patent in suit proposes the use of an alcohol medium solution of hydrogen peroxide which is prepared by catalytic reaction of hydrogen and oxygen in an alcohol single medium using a halogen compound of a platinum group metal in the oxidation process.

In view of the example 1(2) of the contested patent, in which a hydrogen peroxide methanol solution prepared by catalytic reaction of hydrogen and oxygen in methanol has been successfully used in the production of propylene oxide, the Board is satisfied that the technical problem is solved.

3.7 It remains to be decided whether or not the proposed solution is obvious.

3.7.1 As set out above (see point 3.2), the skilled person learns from document (2) that a solution of hydrogen peroxide in methanol would be an excellent reaction medium for the oxidation of propene. Aqueous methanol solutions have been used therein merely as a matter of convenience. Furthermore, document (2) already indicates ways to obtain a mainly water-free reaction medium for the oxidation reaction, namely by azeotropic distillation or by using anhydrous or near-anhydrous organic solutions of hydrogen peroxide (document (2), page 159, left column, last paragraph - right column, line 8).

3.7.2 In view of these clear indications, it is a matter of course that the skilled person merely seeking to provide an alternative process for the preparation of epoxidized products of olefins would turn his attention to documents concerned with the provision of solutions of hydrogen peroxide in methanol. As a skilled person he would be struck by document (1), which belongs to the same field as the patent in suit and which describes the preparation of a solution of hydrogen peroxide in alcohols, for example methanol, by reacting hydrogen and oxygen in the presence of a palladium catalyst containing a palladium halogen compound (example 3 on pages 9-10, particularly page 10, lines 1-3, and examples 1 and 2 for the preparation of the catalyst). Thus, the person skilled in the art following the teaching in document (2) would consider using the methanol solution of hydrogen peroxide of document (1) in the oxidation process of document (2), thereby arriving at the process of the patent in suit without exercising any inventive skills. In addition, document (1) already alerts the skilled person to the fact that hydrogen peroxide generated in situ from hydrogen and oxygen in the presence of an olefin is capable of oxidising that olefin to the corresponding epoxide.

3.7.3 The Respondent argued that the skilled person would not have considered combining the teaching of documents (1) and (2) when seeking to solve the problem underlying the patent in suit. In support for its position the Respondent pointed to the facts that document (2) did not actually disclose an oxidation reaction in pure methanol and always used concentrated hydrogen peroxide solutions. In particular, the Respondent indicated that according to document (2) solutions of 30 to 35 wt% hydrogen peroxide have generally been used. In contrast, the concentration of hydrogen peroxide in methanol according to example 3 of document (1) is considerably lower.

Furthermore, relying on examples 5 and 6 of document (1), the Respondent argued that this document clearly teaches away from the present invention in view of the fact that the selectivity to propylene oxide is clearly much higher in water as solvent (example 6) than in methanol as solvent (example 5).

3.7.4 The Board does not dispute the fact that document (2) does not contain an **explicit** example with pure methanol as the reaction medium of the oxidation reaction. There is however a clear teaching that methanol is the best reaction medium for this purpose (document (2), page 164, left column, lines 6-10). Furthermore, it is apparent from Table (1) of document (2) that a high amount of methanol in the reaction medium has clear advantages for the selectivity and the reaction time (cf. example 3 with example 10 or examples 11 or 12 with example 13). In these circumstances, the Board fails to see the pertinence of this particular argument by the Respondent. Concerning the use of solutions of 30-35 wt% hydrogen peroxide, the Board notes that these values refer to the concentration of the hydrogen peroxide solution from which the oxidation reaction medium has been prepared. The oxidation reaction per se is not conducted at such high concentrations of hydrogen peroxide and does not need concentrated solutions (document (2), page 164, left column, last paragraph, Table 1). Thus, what is decisive is the concentration of hydrogen peroxide in the oxidation reaction medium and not the concentration of the hydrogen peroxide from which the oxidation reaction medium has been prepared. The Board therefore sees no reason why the skilled person, knowing that the oxidation reaction does not require concentrated solutions of hydrogen peroxide, should be discouraged from using the low concentrated hydrogen peroxide methanol solution according to example 3 of document (1) as reaction medium for the oxidation of the olefins.

The Board is not convinced either by the Respondent's arguments that document (1) teaches away from the present invention. Examples 4-6 of document (1) describe the single-step preparation of propylene oxide from olefin, hydrogen and oxygen in butanol, methanol or water as reaction medium. In all three examples various amounts of **propane** are formed in addition to the desired propylene oxide. In view of these results, it is obvious to the skilled person that due to the simultaneous presence of hydrogen and olefin a competitive reaction, namely the hydrogenation of propene to propane, takes place. It is undisputed that the selectivity to propylene oxide is higher when water is used as the reaction medium. However, the only conclusion the skilled person can draw from this fact is that in the **single-step process** of document (1), in which hydrogen and olefin are simultaneously present, the hydrogenation reaction predominates in methanol as a solvent and the oxidation reaction in the presence of water. In the two-step process of the patent in suit such a competitive reaction does not occur, due to the fact the hydrogen is not in contact with the olefin.

The Board therefore sees no reason why document (1) should teach away from the present invention.

3.7.5 Furthermore, the Respondent argued that in contrast to the process of document (2) the presently claimed process has no need for a complex reaction apparatus and can be carried out in fewer steps as no dilution steps are required. Accordingly, this will result in a decrease in costs. Furthermore, document (2) refers to a laboratory scale process while the presently claimed process ultimately aims at a process on an industrial scale. The skilled person had no reason to expect that the conditions under which the laboratory scale process in document (2) was successfully conducted would also work on industrial scale.

3.7.6 The Board is unable to find support for the Respondent's position concerning the complexity of the apparatus. The oxidation process in example 1 (2) of the patent in suit is carried out in an autoclave, just like the oxidation process in document (2) (document (2), figure 1). In addition, figure 1 of document (2) describes control instruments for pressure, flow and temperature, as well as cooling, stirring and pumping devices. In the absence of any details concerning the exact construction of the autoclave employed in example 1(2) of the patent in suit, there is no support for the alleged simplification of the construction of the apparatus. Incidentally, the oxidation process of claim 1 of the patent in suit is not limited to a particular apparatus. Concerning the alleged decrease in the number of steps, it is again pointed out that dilution steps are not a requirement of the oxidation process of document (2). They are merely the consequence of selecting readily available commercial hydrogen peroxide solutions for preparing the oxidation medium (see points 3.5 and 3.7.4 above). Evidence that the process for the preparation of the hydrogen peroxide from hydrogen and oxygen according to step a) of the patent in suit might be more cost-effective than the commonly known process for the aqueous hydrogen peroxide preparation employed in document (2) has not been provided.

Concerning the alleged difference in scale, the Board notes that claim 1 of the patent in suit is directed to a process on any scale, since it does not comprise a feature restricting the claimed process to a particular scale. The Respondent's arguments relating to the scale of the process are therefore not relevant.

3.7.7 Furthermore, the Respondent disputed that the catalyst used in document (1) for the preparation of a methanol solution of hydrogen peroxide falls within the definition of the catalyst according to the patent in suit. In support the Respondent referred to examples 1 and 2 of document (1), in particular to example 2, which describe the preparation of a typical catalyst according to the invention of document (1). Example 2 refers on page 9, lines 15-19 to the bond energy states of the catalyst, formally corresponding to the oxidation stages 0, +1, +2. The Respondent argued that there is no indication in this example as to the presence of palladium chloride in the finished catalyst. In addition, example 2 discloses that the EXAFS (extended X-ray absorption fine structure) measurements showed Pd-O or Pd-N bond distances and the absence of Pd-Pd bond distances; Pd-Cl distances are not mentioned.

The Respondent also pointed out that the catalyst is contacted with hydrogen and that it is known from document (5) that palladium chloride is reduced by hydrogen to metallic palladium. Furthermore, document (5) indicated that compared to all other metals including the platinum group metals, palladium salt solutions are the easiest and quickest to be reduced to metallic palladium. Thus, although the catalyst according to document (1) is prepared from palladium chloride, it cannot safely be assumed that palladium chloride, and therefore a halogen compound of a platinum group metal, is still present in the final catalyst product.

3.7.8 Document (1) refers to oxidation catalysts on the basis of titanium or vanadium silicates and a specific content of one or more platinum-group metals selected from the group of ruthenium, rhodium, palladium, osmium, iridium and platinum, characterised in that the metals are present in at least two different bond energy states. The catalysts are prepared by impregnating or reacting the silicates with a salt solution of the platinum metal. Chlorides and acetates as well as their tetramine complexes are mentioned as suitable salts (document (1), page 3, lines 30 - 47). The distribution of the bond energy states, which correspond to oxidation states, is preferably achieved by **partial** reduction of higher oxidation states of the metal (document (1), page 4, lines 15-30). Example 1 of document (1) describes the preparation of a silicate support. In example 2 this silicate is impregnated with a palladium tetraminochloro complex ($[Pd(NH_3)_4]Cl_2$), i.e. a halogen compound of a platinum group metal, which has been prepared from palladium(II) chloride and ammonia.

Such a tetraminochloro complex has the oxidation state +2. After impregnation the catalyst is dried and **partially** reduced to obtain a finished product which according to X-ray photoelectron spectroscopy has the oxidation states +2, +1 and 0. Since the palladium tetraminochloro complex with an oxidation state of +2 has only partially been reduced, part of this complex in all probability is still present after that partial reduction, which is consistent with the X-ray photoelectron spectroscopy detecting an oxidation state of +2 and with the EXAFS-measurements.

In this context the Respondent's reference to document (5) cannot help its case. It is not disputed that a palladium(II) chloride solution under the right conditions can be reduced completely to metallic palladium as disclosed in document (5). This fact is however irrelevant in the present case, since it is the explicit aim of document (1) to avoid the complete reduction of the palladium salts/complexes to metallic palladium. Thus, part of the initial palladium tetraminochloro complex will not have been reduced after the partial reduction.

The catalyst, which has been used to prepare the methanol solution of hydrogen peroxide in example 3 of document (1), is therefore considered as falling within the definition of the catalyst of step a) of the patent in suit, which according to paragraph [0017] can be supported on a suitable carrier.

3.7.9 Finally, the Respondent argued that the skilled person would have been deterred from using a methanol solution of hydrogen peroxide in view of the teaching in document (2) that the handling of anhydrous or near-anhydrous organic solutions of hydrogen peroxide is unsafe.

3.7.10 The Board is not convinced by the Respondent's arguments. The passage in document (2) on which the Respondent relies is merely a warning for the skilled person that when using potentially dangerous organic solutions of hydrogen peroxide he has to act with care and may have to take precautionary measures. It does not suggest in any way that these solutions would be unsuitable for the oxidation reaction or detrimental to its outcome. This passage therefore does not deter the skilled person from using these solutions. Furthermore, the Board notes that despite this disadvantage, anhydrous or near-anhydrous solutions of hydrogen peroxide have been used before in the oxidation of olefins, as indicated in document (2) (page 159, left column, last paragraph - right column, line 1).

3.8 For the reasons set out above, the Board concludes that the solution of the technical problem underlying the present invention would have been obvious to the person skilled in the art in view of document (2) in combination with document (1). Hence, the subject-matter of the main request does not involve an inventive step within the meaning of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. European patent No. 812 836 is revoked.

The Registrar: The Chairman:

B. Atienza-Vivancos P. Ranguis