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**Datasheet for the decision
of 14 January 2011**

Case Number: T 1761/07 - 3.3.01

Application Number: 02738177.1

Publication Number: 1389195

IPC: C07D 301/12

Language of the proceedings: EN

Title of invention:

Process for manufacturing an oxirane

Patentee:

SOLVAY (Société Anonyme)

Opponents:

Evonik Degussa GmbH
THE DOW CHEMICAL COMPANY

Headword:

Hydrogen peroxide epoxidation/SOLVAY

Relevant legal provisions:

EPC Art. 123(2), 56

Relevant legal provisions (EPC 1973):

-

Keyword:

"Amendments: (allowable) no new information by in
juxtaposition of two independent claims"
"Inventive step (no) - no comparison with prior art -
improvement not shown - selection of contents of organic
solvent, water and hydrogen peroxide obvious for the skilled
person"

Decisions cited:

T 1239/03, T 0181/82, T 0955/96, T 0020/81

Catchword:

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Case Number: T 1761/07 - 3.3.01

D E C I S I O N
of the Technical Board of Appeal 3.3.01
of 14 January 2011

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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
11 September 2007 concerning maintenance of
European patent No. 1389195 in amended form.

Composition of the Board:

Chairman: P. Ranguis
Members: G. Seufert
L. Bühler

Summary of Facts and Submissions

- I. Appellant 1 (Opponent 1), Appellant 2 (Patent Proprietor) and Appellant 3 (Opponent 2) lodged appeals against the interlocutory decision of the Opposition Division of 11 September 2007 on the amended form in which European patent No. 1 389 195 could be maintained.
- II. In this decision the following numbering will be used to refer to the documents:
- (1) WO 00/17178 A1
 - (2) US 5 681 789
 - (3) WO 00/76989 A2
 - (4) EP 230 949 A2
 - (25) EP 1 072 600 A1
 - (26) Calculations provided by Appellant 3 in support of the content of document (25)
- III. Notices of opposition were filed by Appellant 1 and Appellant 3, requesting revocation of the patent in suit in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC).

The Opposition Division held that

- the subject-matter of the main request, namely the set of claims as granted, lacked novelty over documents (1) to (3),
- the auxiliary request filed during oral proceedings complied with the requirements of Rule 57a EPC 1973 (Rule 80 EPC 2000) and Article 123(2) EPC. Its subject-matter was novel

and involved an inventive step, because the skilled person had no incentive to lower the amount of organic solvent in order to solve the underlying technical problem of improving selectivity and conversion rate without significantly deactivating the catalyst.

- IV. With the statement of grounds of appeal, Appellant 2 defended the maintenance of the patent in suit on the set of claims as granted.
- V. In reply to the statements of grounds of appeal by Appellants 1 and 3, Appellant 2 maintained the set of claims as granted as its main request. Furthermore, it defended the patent in suit on the basis of the set of claims filed on 29 June 2007 during oral proceedings before the Opposition Division as its first auxiliary request and filed a second and a third auxiliary request.
- VI. 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 its preliminary opinion. In particular, the Board raised objections under Rule 80 EPC against the first, second and third auxiliary request and a minor clarity objection against the second and third auxiliary request. Furthermore, the Board raised the question whether the calculations of Appellants 1 and 3, being based on certain assumptions, were sufficient to demonstrate beyond reasonable doubt that documents (1) to (3) implicitly disclosed the subject-matter of claim 1 as granted. Concerning inventive step, the Board raised the question whether or not document (4)

was to be considered as the closest prior art and informed the parties that they should also be prepared to discuss inventive step starting from document (3) or (25).

- VII. In reply to the communication of the Board, with letter of 9 November 2010 Appellant 2 filed first to fourth auxiliary requests, superseding all previous auxiliary requests.
- VIII. At the beginning of the oral proceedings before the Board, which took place on 14 January 2011, Appellant 2 withdrew its main request as well as the second and third auxiliary request and declared the first auxiliary request filed with letter of 9 November 2010 to be its new main request and the fourth auxiliary request to be its auxiliary request. In the course of the oral proceedings the Appellant withdrew the auxiliary request and submitted a new auxiliary request, which it also withdrew after the Chairman indicated that the amendments made in this new request were not considered to be suitable to overcome the objection of lack of inventive step.

Independent claims 1 and 11 of the Appellant's new main and sole request read as follows:

"1. Process for manufacturing 1,2-epoxy-3-chloropropane by reaction between allyl chloride and hydrogen peroxide in a reactor containing a liquid phase, in the presence of water, one or more organic solvents, a catalyst and one or more compounds for increasing the selectivity of the catalyst toward epoxidation reactions, characterized in that:

- *if the process is performed in batchwise mode, the liquid phase present in the reactor when the reaction starts*
- *if the process is performed continuously, all of the liquid phases that are fed continuously into the reactor*

has/have a total organic solvent content of at least 0.1 g/kg and of not more than 675 g/kg, and a total content of water plus hydrogen peroxide of at least 100 g/kg."

"11. Process for manufacturing 1,2-epoxypropane by reaction between propylene and hydrogen peroxide in a reactor containing a liquid phase, in the presence of water, one or more organic solvents, a catalyst and one or more compounds for increasing the selectivity of the catalyst toward epoxidation reactions, characterized in that:

- *if the process is performed in batchwise mode, the liquid phase present in the reactor when the reaction starts*
- *if the process is performed continuously, all of the liquid phases that are fed continuously into the reactor*

has/have a total organic solvent content of at least 0.1 g/kg and of not more than 600 g/kg, and a total content of water plus hydrogen peroxide of at least 100 g/kg."

IX. Appellant 1's arguments, to the extent that they are relevant for this decision, can be summarised as follows:

- *amendments*

The subject-matter of the main request extended beyond the application as originally filed, because the juxtaposition of the two independent claims 1 and 11 introduced new technical information, namely to use different contents of organic solvent depending on the olefins to be used in the epoxidation reaction, whereas in the application as filed all olefins were described as equivalent. This new teaching was even more pronounced if the amendments which had been made to the description during opposition proceedings were taken into consideration. In this context reference was made to decision T 1239/03.

- *inventive step*

The subject-matter of claims 1 and 11 concerning the batch mode was not inventive in view of the teaching of document (4), in particular examples 3 and 6. The problem to be solved in the light of this document was the provision of an alternative process for the manufacturing of 1,2-epoxypropane and 1,2-epoxy-3-chloropropane, because the selectivity was already high in the examples of document (4) and the patent in suit did not contain comparative data demonstrating any improved effects associated with the distinguishing feature, namely the addition of the selectivity enhancer at a different time, in test series 1 and 2 comparison had been made with an untreated catalyst, and/or the choice of a particular content of organic solvent and water plus hydrogen peroxide. The use of

the selectivity enhancer during epoxidation reaction was explicitly suggested in document (4). So was the use of an organic solvent. The selection of particular contents belonged to the routine activity of the skilled person.

The continuous process according to claim 11 of the main request was not inventive in view of the teaching of document (25), in particular examples 3, 4 and 5, where the selectivity was high and the deactivation of the catalyst minimal. Document (25) differed from the patent in suit in the amount of organic solvent. The examples in the patent in suit did not demonstrate an improvement in selectivity and did not allow any conclusion as to the deactivation of the catalyst, since the conversion of hydrogen peroxide had been measured only once. They were also not suitable to demonstrate an improvement in hydrogen peroxide conversion, because the working example and comparative example in the patent in suit differed in more than the distinguishing feature from document (25). The problem to be solved was therefore the provision of an alternative process. Document (25) already explicitly suggested the use of methanol/water mixtures with a weight ratio of 50/50, which starting from the examples of document (25) inevitably led to a content of methanol and water plus/hydrogen peroxide within the claimed limits.

- X. Appellant 2's arguments, to the extent that they are relevant for this decision, can be summarised as follows:

- *amendments*

Claims 1 and 11 of the main request were supported by claims 1 and 2 as granted and page 4, lines 12-13 of the original description, which mentioned allyl chloride and propylene as the preferred olefins. The arguments of Appellant 1 regarding the separation into two independent claims were more related to the question whether or not unity existed between the present claims, and unity was not a ground for opposition. The fact that the limiting feature was not the same in both claims could not be considered as extension beyond the application as originally filed, because both these features had been originally disclosed.

- *inventive step*

The subject-matter of the main request was inventive over the teaching of documents (4) and (25). The use of selectivity enhancers in epoxidation reactions, which was known in the art, had the disadvantage of reducing the catalyst activity and made it necessary to frequently replace the deactivated catalyst. The problem to be solved was therefore the provision of an epoxidation process that showed high selectivity and high conversion as well as a minimum deactivation of the catalyst. This problem was solved by keeping the total content of organic solvents and the total content of water plus hydrogen peroxide within the claimed limits as shown in the examples of the patent in suit. Neither document (4) nor document (25) disclosed this concept. Document (4) did not use a selectivity enhancer in the batch process, but relied on the modification of the catalyst and could therefore not render the claimed subject-matter obvious, especially

in view of the known disadvantages related to the use of selectivity enhancers.

Document (25) taught a different solution, namely to use specific selectivity enhancers. Neither from the description nor from the examples of document (25) was it apparent that the amount of organic solvent and the amount of water plus hydrogen peroxide might be in any way critical for yield, selectivity or durability of the catalyst.

XI. Appellant 3's arguments, to the extent that they are relevant for this decision, can be summarised as follows:

- *amendments*

Concerning the objection under Article 123(2) EPC raised by Appellant 1, there were no additional comments.

- *inventive step*

The subject-matter of claim 11 was not inventive over documents (4) and (25), in particular in view of example 3 of document (4) and example 6 of document (25). Example 3 of document (4) already achieved high conversion of hydrogen peroxide and high selectivity towards the epoxide. Since the examples in the patent in suit were run continuously with addition of the selectivity enhancer, and the example in document (4) was run in batch mode with a pre-treated catalyst, their comparison was not appropriate to demonstrate any improvements concerning catalyst deactivation. Document (4) also referred to a continuous process with the selectivity enhancer added

during the reaction, without however providing any explicit examples. Example 6 in document (25) reflected such an experiment. With sodium acetate as enhancer and a methanol content of 702 g/kg and a water plus hydrogen peroxide content of 182 g/kg, conversion and selectivity at 30 hours were essentially identical to the working example of the patent in suit. Moreover, document (25) also suggested other selectivity enhancers for improved catalyst life time. There was no evidence as to the criticality of the upper limit of the organic solvent content and no improvement or unexpected effect had been demonstrated compared to document (4), illustrated via example 6 of document (25). The technical problem to be solved was therefore the provision of an alternative. Varying the amount of components in the reaction system was a routine measure for the skilled person, if faced with the problem of providing of a mere alternative.

- XII. Appellants 1 and 3 requested that the decision under appeal be set aside and European patent No. 1 389 195 revoked.
- XIII. Appellant 2 requested that the decision under appeal be set aside and the patent maintained on the basis of the main request, which had been filed as first auxiliary request with letter dated 9 November 2010.
- XIV. At the end of the oral proceedings the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

Main and sole request

2. *Amendments*

- 2.1 In the main request the single independent claim 1 of the patent as granted, referring to a process for the manufacturing of an oxirane (epoxide), has been split into two independent claims, limited to the manufacture of two specific epoxides, in order to avoid an objection of lack of novelty raised by Appellants 1 and 3.

Independent claim 1 is directed to the manufacture of **1,2-epoxy-3-chloropropane from allyl chloride**; the total organic solvent content compared to claim 1 as granted remained unchanged, namely at least 0.1 g/kg and not more than 675 g/kg. Independent claim 11 is directed to the manufacture of **1,2-epoxypropane from propylene**; the total organic solvent content has changed to 0.1 g/kg and not more than **600 g/kg**.

- 2.2 According to Appellant 1 these amendments extended the subject-matter of the patent in suit beyond the content of the application as originally filed, as they impart to the person skilled in the art a new technical teaching, namely to select the upper limit of the content of organic solvent in relation to the olefin to be used. Such a differentiation between olefins was not clearly and unambiguously derivable from the application as filed, where all olefins were considered

equivalent. In support for its arguments Appellant 1 referred to page 1, line 27 - page 2, line 2, page 3, lines 19-25 and claims 1 and 2 of the application as originally filed, where the upper limit of the organic solvent was disclosed only in combination with the generic term "olefins". A general definition of the olefins and the corresponding epoxides could be found on page 4, lines 1-13 of the application as filed. Allyl chloride and propylene were mentioned in lines 12-13 of that page, but no distinction was made between these olefins.

Appellant 1 also argued that in order to determine whether or not an amendment offended against Article 123(2) EPC it was not sufficient to establish whether each amended claim per se was supported by the application as filed, but whether as a consequence of the amendments technical information was introduced which a skilled person would not have objectively and unambiguously derived from the application as filed. Even amendments which did not concern the claims could result in subject-matter extending beyond the application as filed. In support of this argument, Appellant 1 referred to the decision T 1239/03, particularly point 3.3.2 of the reasons. In this context the Appellant also pointed out that the description, which had been amended during the opposition procedure, showed quite clearly the new technical information introduced into the patent in suit, namely to select different contents of organic solvents for different olefins.

2.3 The Board is not convinced by the arguments of Appellant 1.

2.3.1 Claim 1 of the application as originally filed refers to the epoxidation reaction of an olefin whereby depending on the reaction mode either the liquid phase present in the reactor when the reaction starts or all the liquid phases that are fed continuously into the reactor has/have a total organic solvent content of at least 0.1 g/kg and not more to 675 g/kg. Dependent claim 2 as originally filed is directed to a preferred embodiment with an upper limit of the total organic solvent content of 600 g/kg. It is furthermore clearly apparent from the application as originally filed that the use of allyl chloride, resulting in the formation of 1,2-epoxy-3-chloropropane, and the use of propylene, leading to the formation of 1,2-epoxypropane, are particularly preferred embodiments. This is already clear from the very first paragraph of the description as originally filed, as well as from page 4, lines 11-13. Further indications, although in a more specific context, can be found in the paragraph bridging pages 5 and 6 or in claim 7 as originally filed. Thus, the use of these preferred olefins in a process according to any of the claims of the application as filed, for example claims 1 or 2 or claim 3, which refers back to claims 1 and 2 and discloses the total water and hydrogen peroxide content, is clearly and unambiguously derivable for the skilled reader (selection from one list). In other words, the manufacturing process for either 1,2-epoxy-3-chloropropane or 1,2-epoxypropane with a total content of organic solvent of at least 0.1 g/kg to not more than 675 g/kg and a total content of water plus hydrogen peroxide of at least 100 g/kg (claims 1 and 3 as originally filed) or, more preferably, with a

content of 0.1 g/kg to not more than 600 g/kg (claims 2 and 3 as originally filed) is clearly disclosed.

The main request has been amended by deleting just one of these clearly and unambiguously derivable possibilities, namely the manufacturing of 1,2-epoxypropane with a content of organic solvent of 0.1 to 675 g/kg. Independent claims 1 and 11 refer to the remaining three possibilities, which are also clearly derivable from the application as filed. This deletion of one of the possibilities does not change the technical information conveyed to the skilled reader; it merely excludes one of the previously disclosed possibilities from the scope of the claims. Nor can it be said that these amendments amount to a new teaching for the skilled reader, namely to select **different** reaction conditions, i.e. **different** organic solvent contents, depending on the olefin to be chosen. There are no indications in the application as filed that different effects may be related to the use of an organic solvent content in the area between 600 and 675 g/kg compared to the area between 0.1 to 600 g/kg. Consequently, no "differentiation" between propylene or allyl chloride is apparent.

- 2.3.2 Concerning the amended description, Appellant 2 during oral proceedings explicitly declared that this amended description did not form part of its main request. The description would have to be adapted to the claims if the Board concluded that the requirements of the EPC were met. Consequently, there was no need for the Board to decide on the description as amended during opposition procedure.

2.3.3 The reference to decision T 1293/03 cannot support Appellant 1's case either. The Board notes that this decision concerns a rather different situation, where it had to be decided whether or not the meaning of an unclear term which was used in the claims and which allowed two ways of interpretation, none of which was clearly and unambiguously excluded by the application as filed, had changed by deleting two examples. With regard to the statement in point 3.3.2 of the decision T 1239/03, the Board does not dispute the fact that any amendment to a patent presenting the skilled person with information which is not clearly and unambiguously derivable from the application as filed infringes Article 123(2) EPC. However as set out in point 2.3.1 above, the subject-matter of the main request is clearly und unambiguously derivable from the application as filed and does not add new information for the skilled reader.

2.4 From the above, the Board concludes that the subject-matter of the main request does not extend beyond the content of the application as filed. Thus, the requirements of Article 123(2) EPC are satisfied. The amendments made result in a restriction of the scope of the claims as granted and therefore of the protection conferred. Hence, Article 123(3) EPC is complied with, which was never contested by Appellants 1 and 3.

2.5 The objection under Rule 80 EPC raised by the Board in its preliminary opinion against the first auxiliary request was overcome by deleting the dependent claim concerned in the amended first request filed with letter of 9 November 2010, which is now Appellant 2's main and sole request (point VIII above).

3. *Novelty*

Appellants 1 and 3 did not raise any objection with regard to novelty of the main request, and the Board too sees no reason to do so. Thus, the main request is considered to be novel within the meaning of Article 54 EPC.

4. *Inventive step*

4.1 Independent claims 1 and 11 of the sole request are directed to a batch or continuous preparation of 1,2-epoxy-3-chloropropane or 1,2-epoxypropane via the epoxidation of allyl chloride or propylene with hydrogen peroxide in a reactor containing a liquid phase in the presence of water, organic solvent(s), a catalyst and a selectivity enhancer. The liquid phase, which is defined as the phase at the beginning of reaction (batch mode) or as all of the liquid phases fed continuously into the reactor, has a total organic solvent content of at least 0.1 g/kg and not more than 675 g/kg for 1,2-epoxy-3-chloropropane and not more than 600 g/kg for 1,2-epoxypropane and a total content of water plus hydrogen peroxide of at least 100 g/kg.

4.2 Similar epoxidation reactions either in batch or in continuous mode in the presence of selectivity enhancers already belong to the state of the art.

The epoxidation of olefins to their corresponding epoxides in the presence of water, an organic solvent, a catalyst and a basic substance as a selectivity

enhancer is described in document (4) (claim 3; page 2, lines 25-30, page 5, lines 13-20, examples 3 and 6). The enhancer can be added either before and/or during the reaction. In example 3 of document (4) propylene was reacted in an autoclave (batch mode) with hydrogen peroxide in the presence of a catalyst, which was treated before the reaction with sodium acetate as selectivity enhancer. The reaction was carried out in a methanol and water mixture. The liquid phase at the start of the reaction had a methanol content of 527 g/kg and a total content of water plus hydrogen peroxide of 473 g/kg. In example 6 of document (4) allyl chloride was reacted in an autoclave with hydrogen peroxide in the presence of a catalyst, which was treated before its use with sodium acetate as selectivity enhancer, methanol and water. The liquid phase had a methanol content of 701 g/kg and a total content of water plus hydrogen peroxide of 123 g/kg. Document (4) also mentioned a continuous process with the addition of a selectivity enhancer without, however, providing process details or examples (page 4, lines 10-23).

Document (25) disclosed a continuous process for the epoxidation of olefins with hydrogen peroxide in a solvent medium in the presence of a catalyst and a buffer system with a pH controlled within values ranging from 5.5 to 8.0 as selectivity enhancer (paragraph [0014]). Examples 3, 4 and 5 described the continuous epoxidation of propylene with hydrogen peroxide in the presence of titanium silicalite TS-1, which is the same catalyst as used in the example of the patent in suit, methanol and various buffer systems. The overall reaction mixture in the feeding

(without propylene) was equal to 2300 g/h with a composition of 3.5% hydrogen peroxide, 17% water and 79.5% methanol. The pressure in the reactor is maintained at 12 bar, feeding propylene. According to uncontested calculations provided by Appellant 1 and Appellant 3, supported by document (26), the total content of methanol and water plus hydrogen peroxide in the continuously fed liquid phases can be calculated to be either 795 g/kg and 205 g/kg or 702 g/kg and 182 g/kg, depending on whether propylene is introduced in gaseous or liquid form.

4.3 It is undisputed by all parties that both documents (4) and (25) represent the closest state of the art. In view of the different reaction modes claimed in the present invention, the Board considers it appropriate to take both documents in turn as starting point for assessing inventive step.

4.4 In view of this prior art the problem to be solved as formulated by Appellant 2 was the provision of a process for the preparation of 1,2-epoxy-3-chloropropane or 1,2-epoxypropane that showed high selectivity and high conversion as well as minimum deactivation of the catalyst. According to Appellant 2 it was known in the art that the presence of selectivity enhancers caused reduction in the catalyst activity and made it necessary to frequently replace the catalyst, as it became deactivated. The patent in suit proposes to solve this problem by keeping the content of organic solvent within a certain range and the content of water plus hydrogen peroxide above a certain limit. In support of his assertions, Appellant 2 relied on two test series described in the

patent in suit, comparing their degree of conversion and selectivity. Series 1 was run without a selectivity enhancer or with three different selectivity enhancers in a continuous process using 860 g/kg methanol and 90 g/kg water plus hydrogen peroxide and represented the comparative example carried out with both contents outside the presently claimed limits. Series 2 was run without a selectivity enhancer or with the same three selectivity enhancers as in series 1 in a continuous process using 530 g/kg methanol and 460 g/kg water plus hydrogen peroxide, which represented contents according to the invention. Referring to table 3 of the patent in suit, Appellant 2 pointed out that the addition of selectivity enhancers showed the expected increase in selectivity and the expected deactivation of the catalyst, if the epoxidation reaction was carried out in the presence of a high content of methanol. Working at a lower content of methanol still gave the increase in selectivity, but surprisingly showed no negative influence on the activity of the catalyst.

- 4.5 It is established jurisprudence of the Boards of Appeal that some beneficial effects or advantageous properties, if appropriately demonstrated by means of truly comparable results, can in certain circumstances properly form a basis for the definition of the problem that the claimed invention sets out to solve and can, in principle, be regarded as an indication of inventive step. The only comparative tests suitable for this are, however, those which are concerned with the structurally closest state of the art to the invention, because it is only here that the factor of

unexpectedness is to be sought (see T 181/82, OJ EPO 1984, 401, point 5 and T 955/96, point 5.10).

4.5.1 It has to be remarked that in the patent in suit only two parameters have been measured: selectivity towards the epoxide and the conversion of hydrogen peroxide after 24 hours (see table 3 of the patent in suit). The hydrogen peroxide conversion has been used to demonstrate the activity of the catalyst. High hydrogen peroxide conversion and minimum deactivation (see Appellant's formulation of the problem, point 4.4 above) are therefore not separate quantities but reflect the same characteristic, namely the activity of the catalyst

4.5.2 Test series 1 of the patent in suit, which represents the comparative example, has been carried out in a continuous manner with a total amount of organic solvent of 860 g/kg and at total content of water plus hydrogen peroxide of 90 g/kg. However, the contents used in test series 1 do not represent the contents that have been used in the processes of documents (4) or (25), which were considered to represent the closest prior art. In the continuous examples 3, 4 and 5 of document (25), the amount of methanol used was above the claimed value (795 g/kg or 702 g/kg) but still below the content of comparative test series 1. The amount of water plus hydrogen peroxide in the aforementioned prior art examples was above 100 g/kg as presently claimed. Comparative data demonstrating any effect, in particular on the catalyst activity, when the methanol content is lowered, i.e. an indication that the upper limit of 675 g/kg or 600 g/kg is in any way critical for the invention, have not been provided.

Examples 3 and 6 of document (4) were carried out with a water plus hydrogen peroxide content of more than 100 g/kg. In example 3 the amount of methanol was within the claimed limits, the only difference being the addition of the selectivity enhancer at a different point in time, and in example 6, where the same pre-treated catalyst is used, the amount of methanol is slightly above the claimed upper limit (701 g/kg). The patent in suit does not contain any examples run in a batch mode, let alone a comparison between the batch process of the prior art and the claimed batch process, and thus cannot demonstrate any effects. There is also no experimental data showing that the addition of the selectivity enhancer during the epoxidation reaction has any detrimental effect on the catalyst activity as compared to the treatment of the catalyst with the selectivity enhancer before its reaction. Test series 1, notwithstanding the fact that it was run continuously, used an untreated catalyst for comparison.

Hence, the experimental data relied upon by Appellant 2 do not provide a comparison with the prior art closest to the invention and thus cannot demonstrate any effect on catalyst activity. In this context it should be noted that the high selectivity is due to the presence of a selectivity enhancer and is not related in any way to the content of organic solvent and water plus hydrogen peroxide.

4.5.3 Furthermore, the experimental data of the patent in suit are not appropriate to demonstrate a causal link between the claimed contents of organic solvent and water plus hydrogen peroxide and the alleged improvement regarding catalyst deactivation. This is

due not so much to the fact that there are not more examples in the patent in suit covering the claimed range, but to the fact that the criticality of the claimed upper and/or lower limits has not been demonstrated. There are no examples in the patent in suit comparing a process run with an organic solvent content close to and below the upper limit with a process run with an organic solvent content close to and above that limit. In the comparative test series 1 the content of methanol is **830 g/kg**. In the example according to the invention (test series 2) the amount is **530 g/kg** and the claimed upper limit is **675 g/kg**. As pointed out above (point 4.5.2), processes run with a content of methanol above the claimed limit also led to high selectivity and conversion. There is also no evidence demonstrating the criticality of the lower limit for the organic solvent content, be that 0.1 g/kg as claimed or 1 g/kg, 10 g/kg or 50 g/kg as referred to in the description. Nor is there an example in the patent in suit in which the water plus hydrogen peroxide content is close to and inside the lower limit, in order to demonstrate the criticality of the claimed lower limit of 100 g/kg. In comparative test series 1 the content of water plus hydrogen peroxide is **90 g/kg**, in test series 2 the content is **460 g/kg**. In the absence of data, the claimed content of organic solvent as well as the claimed content of water plus hydrogen peroxide can only be considered to be an arbitrary choice which has not been shown to be decisive for an improvement with regard to the deactivation of the catalyst.

- 4.6 Since, according to the established jurisprudence of the Boards of Appeal, alleged but unsupported

advantages cannot be taken into consideration in respect of the determination of the problem underlying the invention (see decision T 20/81, OJ EPO 1982, 217, point 3 of the reasons), the objective problem to be solved in the light of documents (4) and (25) is the provision of an alternative process for the selective manufacture of 1,2-epoxypropane and 1,2-epoxy-3-chloropropane from allyl chloride or propylene with hydrogen peroxide.

4.7 It was never in dispute or in doubt that allyl chloride and propylene can be converted into the corresponding epoxides by the presently claimed process. Furthermore, by definition, a selectivity enhancer enhances the selectivity towards the epoxide.

4.8 It then remains to be decided whether or not the proposed solution is obvious in view of the state of the art.

4.8.1 Document (4) describes the use of acid neutralisation agents as selectivity enhancers in epoxidation reactions of olefins (page 2, lines 25-30). These enhancers can be added either before, i.e. in a separate treatment step of the catalyst, and/or **during** the reaction (page 2, line 28, page 3, lines 24-26, claim 3). With regard to solvents, document (4) discloses on page 5, lines 3-7 that the epoxidation reaction can be carried out with or without the presence of one or more solvents. Alcohols, ketones, esters, ethers and glycols are mentioned as organic solvents, with methanol being the preferred alcohol.

To arrive at the presently claimed batch process the person skilled in the art merely had to pick out one of the alternatives explicitly disclosed in document (4), namely neutralising the catalyst during the epoxidation reaction, and select a certain content of organic solvent and water plus hydrogen peroxide, to which the explicit examples already provide clear guidance. Without any surprising or unexpected effects, this represents merely an arbitrary choice made within the general teaching of document (4). Such an arbitrary choice is within the routine activity of the skilled person and does not require inventive skills.

- 4.8.2 Document (25) discloses in paragraphs [0028] on page 4, the optional use of a(n) (organic) solvent. Particularly preferred is a mixture of methanol and water with a weight range of 50/50 to 99/1. According to uncontested calculations by Appellant 1, the use of a methanol/water mixture with a weight range of 50/50 instead of the 92.7/7.3 mixture used in examples 3, 4 and 5 of document (25), results in a methanol content between 378 g/kg and 428 g/kg and a content of water plus hydrogen peroxide of between 474 g/kg and 572 g/kg, depending on whether propylene is added in gaseous or liquid form.

The contents of the organic solvent and water plus hydrogen is neither critical nor a purposive choice for solving the objective technical problem, since no surprising or unexpected effect has been shown to be associated with these particular contents. Picking out a combination of contents of organic solvents and water plus hydrogen peroxide, especially a combination that was already suggested in document (25), is within the

routine activity of the skilled person faced with the problem of providing a mere alternative process for the preparation of 1,2-epoxypropane or 1,2-epoxy-3-chloropropane.

4.9 With regard to the epoxidation reaction carried out in batch mode, the Appellant argued that document (4) taught an entirely different concept for providing high selectivity and high productivity, namely to use a very specific catalyst which was modified in such a way that the addition of a separate selectivity enhancer was not necessary (see document (4), page 7, lines 6-23). Thus, the difference between the process of document (4) and the batch process of the patent in suit lies in the presence of a selectivity enhancer. Instead of using a selectivity enhancer, document (4) suggested neutralisation of the catalyst with a basic substance followed by complete removal of the excess base (document (4), page 3, line 35 to page 4, line 8). Furthermore, it is known, and was acknowledged in paragraph [0003] of the patent in suit, that the addition of a selectivity enhancer generally resulted in a reduction of the catalyst activity (i.e. the hydrogen peroxide conversion). Thus, the skilled person had no reason to add a selectivity enhancer to the batch process disclosed in document (4) and to assume that the degree of conversion of the hydrogen peroxide was not negatively affected.

4.10 The Board does not agree with Appellant 2's argument that document (4) does not disclose the use of a selectivity enhancer for the batch process. On the contrary, the use of acid neutralisation agents, which interact with the acidic sites of the catalyst, and as

a consequence **increase the selectivity** by reducing the formation of by-products, is clearly disclosed on page 2, lines 25-30, page 3, lines 4-7 of document (4). The difference to the claimed batch process lies in the fact that the selectivity enhancer was added at a different point in time, namely by neutralising the catalyst before its use. Document (4), however, also clearly discloses that there are alternative ways to neutralise the active site of the catalyst, namely **during the reaction** (see claim 2 of document (4)). Although the batch examples 3 and 6 of document (4) have been carried out with a pre-treated catalyst and the same pre-treatment is suggested on page 3, line 35 to page 4, line 8, this has not been understood as a limitation of the batch process exclusively to this alternative. Neither is the removal of the excess base to which Appellant 2 referred an indication that a selectivity enhancer should not be present during the reaction. The removal of the **excess** base in document (4) is merely described as a process step in the realisation of one of the alternatives, namely the alternative whereby the catalyst is treated with the selectivity enhancer (neutralisation agent) before the epoxidation reaction. The only conclusion that can be drawn is that after the acidic sites of the catalyst have been neutralised, **further** neutralisation is not necessary. As the use of a selectivity enhancer and its addition during the epoxidation reaction is already disclosed in document (4), Appellant 2's argument concerning a different concept is not convincing.

Regarding the allegedly expected negative effect on the catalytic activity associated with the addition of selectivity enhancers to the reaction medium, which

would deter the skilled person from using this alternative, it is to be remarked that the problem to be solved merely consisted in providing a further process for the manufacture of 1,2-epoxypropane and 1,2-epoxy-3-chloropropane with enhanced selectivity. Moreover, paragraph [0003], which Appellant 2 used in support of his assertion concerning the expected negative influence of selectivity enhancer, merely refers to two patent documents without providing any information as to the particular metal salts or the general circumstances that have been used therein. Nor is it apparent how the disclosure in these documents is related to the teaching in document (4). Finally, the statement in paragraph [0003] does not appear to reflect the situation correctly, as the influence of a selectivity enhancer on the activity of the catalyst apparently depends on the type of selectivity enhancer and/or, more importantly, on its concentration (see page 2, line 16 to page 3, line 7 of the introductory part of document (3)). Particularly at low concentrations (also used in the patent in suit), a negative influence was not necessarily expected. The statement that the addition of selectivity enhancers generally result in a reduction of activity which would deter the skilled person from adding selectivity enhancers during the epoxidation reaction is therefore not considered to be justified.

- 4.11 With regard to the continuous epoxidation reaction as disclosed in document (25), Appellant 2 relied again on the argument that this document related to an entirely different concept, namely the use of specific selectivity enhancers, in order to provide a process for preparing 1,2-epoxypropane with good yield, good

selectivity and improved duration of the catalytic cycle. Neither the content of organic solvent nor the content of water and hydrogen peroxide was disclosed as in any way critical for the activity of the catalyst. Rather, the pH of the reaction system was considered to be the relevant parameter. Appellant 2 further pointed out that the examples in document (25) were carried out quite differently from test series 1 and 2 of the patent in suit. According to document (25) four separate streams are fed to the reactor, while in the patent in suit only one stream is used.

- 4.12 However, the use of the specific selectivity enhancer according to document (25) is entirely encompassed by the subject-matter presently claimed. The claims of the main request are directed in general to the presence of one or more compounds for increasing the selectivity of the catalyst towards epoxidation reaction, an effect which is achieved by the buffer system of document (25). Moreover, according to page 2, lines 52-53 buffer systems are suitable selectivity enhancers of the patent in suit. Furthermore, as explained in point 4.6 above, the technical problem to be solved was merely the provision of a further process for the production of certain epoxides with enhanced selectivity, for which the presence of the selectivity enhancer is responsible. It is therefore of no relevance that document (25) pays no particular attention to the contents of the organic solvent and/or of water/hydrogen peroxide.

Nor can Appellant 2's argument concerning the different way of carrying out the examples in document (25) be considered convincing. The presently claimed continuous

process is not limited to a particular way of adding the liquid streams; it refers to the solvent and water/hydrogen peroxide content of **all the liquid phases** that are fed continuously. This includes separately fed streams as well as feeding all the liquid phases in one stream.

- 4.13 For the aforementioned reasons the Board concludes that the subject-matter of the main request is obvious to the skilled person in the light of the prior art and 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. The patent is revoked.

The Registrar:

The Chairman:

M. Schalow

P. Ranguis