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D E C I S I O N
of 5 August 2003

Case Number: T 0026/01 - 3.3.1

Application Number: 95200012.3

Publication Number: 0662468

IPC: C07C 69/716

Language of the proceedings: EN

Title of invention:

Process for the preparation of 5-formylvalerate

Patentee:

DSM N.V., et al

Opponent:

BASF Aktiengesellschaft Patente, Marken und Lizenzen

Headword:

Formylvalerate/DSM

Relevant legal provisions:

EPC Art. 54, 56, 123

Keyword:

"Novelty (yes) - prior art silent about feature - no implicit disclosure - inadequate evidence"

"Inventive step (no) - obvious to try - no deterrent teaching in the art"

Decisions cited:

T 0022/81, T 0099/85, T 0800/91, T 0955/93, T 0068/95

Catchword:

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Case Number: T 0026/01 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 5 August 2003

Appellant:
(Opponent)

BASF Aktiengesellschaft
Patente, Marken und Lizenzen
D-67056 Ludwigshafen (DE)

Representative:

-

Respondent:
(Proprietor of the patent)

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NL-6411 TE Heerlen (NL)

Representative:

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted 16 October 2000
rejecting the opposition filed against European
patent No. 0662468 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: A. J. Nuss
Members: R. Freimuth
M. J. Vogel

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal on 21 December 2000 against the decision of the Opposition Division posted on 16 October 2000 rejecting the opposition against European patent No. 662 468 which was granted on the basis of eight claims, the only independent claim 1 reading as follows:

"1. Process for the preparation of a 5-formylvalerate ester by hydroformylating a mixture of pentenoate esters in the presence of a catalyst system which catalyst system comprises a metal selected from groups 8-10 of the Periodic Table of Elements and a mono- or multidentate organic phosphorous ligand, characterized in that the mixture of pentenoate esters contains less than 500 ppm hydroperoxide compounds."

II. Notice of Opposition had been filed by the Appellant requesting revocation of the patent as granted in its entirety on the grounds of insufficient disclosure and lack of inventive step. *Inter alia* the following documents were submitted in opposition proceedings:

(2) US-A-5 264 616,

(4) US-A-4 801 738 and

(8) EP-A-423 769.

III. The Opposition Division held that the invention was sufficiently disclosed and that the claimed subject-matter was novel and involved an inventive step.

The skilled person had no difficulties in carrying out the hydroformylation process since that process was a reaction well known in the art. The claimed invention was also novel over document (4) as that document made no reference whatsoever to the hydroperoxide content of the pentenoate esters used in the hydroformylation process. The removal of hydroperoxides to a concentration below 500 ppm could not be inferred from document (4).

Starting from document (2) as the closest prior art, the problem to be solved was seen in the provision of an improved process for the preparation of 5-formylvalerate ester wherein the activity of the catalyst system was high and would remain high for a prolonged period of time. The solution to this problem consisted in a content of less than 500 ppm hydroperoxide in the starting pentenoate esters. None of the prior art documents, including document (2), concerning the hydroformylation of pentenoate esters suggested the existence of peroxides. There was no reason why the skilled person would have turned to document (8) and would have recognised that, out of the poisons listed therein, peroxides were those causing the problem in the process of document (2). Therefore the claimed process was considered to be non-obvious.

IV. The Respondent (Proprietor of the patent) defended the maintenance of the patent in suit on the basis of the claims as granted and subsidiarily on the basis of the amended claims submitted as first and second auxiliary request on 4 July 2000. Claim 1 of the first and of the second auxiliary request differed from claim 1 according to claim 1 as granted exclusively in that the

mixture of pentenoate esters was "containing at least 20% 3-pentenoate ester" and was "comprising cis 2-pentenoate ester", respectively.

- V. The Appellant argued that document (4), in particular the example therein, anticipated the subject-matter claimed. All the features of process claim 1 apart from the upper limit of 500 ppm of hydroperoxides present in the pentenoate esters were specifically disclosed in document (4). The presence of oxygen not being indicated in that example, hydroperoxides could not be formed in those pentenoate esters with the consequence that they were also in keeping with this feature. Moreover, since a distillation was carried out in that example of document (4), the distilled pentenoate esters necessarily satisfied the feature of claim 1 of having a hydroperoxide content of less than 500 ppm. In order to support his submission the Appellant filed a test report together with the Statement of the Grounds of Appeal wherein a particular pentenoate ester mixture, after distillation, showed a hydroperoxide content of 4 ppm, i.e. below the claimed limit.

In the assessment of inventive step the Appellant started from document (2) and the problem underlying the invention was to overcome the drawbacks of the prior art of catalyst deactivation over time and, thus, to be seen in the improvement of catalyst lifetime. Document (8) dealt with the hydroformylation of olefins wherein no critical limitation was put on the olefins to be used and the catalyst system used was identical. This document gave a hint on how problems with the catalyst system could be solved. Thus, it taught to remove catalyst poisons, which would reduce catalyst

lifetime, from the olefins by conventional methods, e.g. by distillation. Hydroperoxides were indicated to act as catalyst poisons. Therefore the solution proposed in claim 1 of keeping the hydroperoxide content low was obvious.

The auxiliary requests lacked inventive step for the same reasons. Their additional features were already known from the closest document (2) and, thus could not contribute to inventive step.

- VI. The Respondent submitted that document (4) was not novelty destroying as the hydroperoxide content indicated in claim 1 was not directly and unambiguously derivable from that document. The Appellant's test report was not pertinent since it did not reproduce the example of document (4): the mixtures of pentenoate esters used in that document and in the test report differed substantially rendering them incomparable. Furthermore the operation conditions of the distillation were not specified in the test report.

The assessment of inventive step should start from document (2) and the problem to be solved consisted in prolonging catalyst lifetime. The claimed invention differed from that document exclusively in comprising less than 500 ppm hydroperoxide in the pentenoate esters. The Respondent submitted at the oral proceedings before the Board that the limit of 500 ppm as such was not critical for the invention, only the reduction of hydroperoxides to a low content was essential. The prior art did not render the subject-matter of claim 1 obvious since it was unknown that hydroperoxides were formed from the pentenoate esters

and that those hydroperoxides were contributing to the deactivation of the catalyst, i.e. to the reduction of catalyst lifetime. Document (8) was directed to the hydroformylation of olefins without addressing pentenoate esters and dealt with the problem of reducing low boiling components. Its teaching having regard to catalyst poisons was merely a passing remark. The skilled person would only have taken that remark into account if he had expected the presence of hydroperoxides in pentenoate esters to cause problems to the catalyst what he did not.

With respect to the first auxiliary request the Respondent conceded that the additional feature in claim 1 thereof did not contribute to an inventive step. Due to the mandatory presence of cis 2-pentenoate ester, which was the fresh feature in claim 1 of the second auxiliary request, hydroperoxides were formed more easily which was even more unexpected to the skilled person.

VII. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested that the appeal be dismissed and the patent be maintained as granted and subsidiarily that the patent be maintained in the form as amended according to the first or second auxiliary request submitted on 4 July 2003.

VIII. At the end of the oral proceedings held on 5 August 2003 the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Insufficiency of the disclosure of the invention*

The insufficiency of the disclosure of the invention was not at issue in this appeal and the Board is satisfied that the patent in suit discloses the invention in a manner sufficiently clear and complete to be carried out by a person skilled in the art. Although raised as a ground for opposition by the Appellant, the Opposition Division has already rejected this ground. Since it was no longer in dispute before the Board, no detailed reasoning needs to be given.

3. *Novelty*

The Appellant challenged the novelty of the claimed invention exclusively with regard to document (4), not relying on any further document cited so far in the proceedings. Therefore, the Board limits its considerations with respect to novelty to that document.

- 3.1 Document (4) is directed to a process for the preparation of 5-formylvalerate by hydroformylating pentenoate esters using a Rh/organic phosphine catalyst system (claim 1). That process is exemplified in the sole example on column 3. In the claimed process, however, the hydroperoxide content in the pentenoate esters is less than 500 parts per million (claim 1).

3.2 Document (4) is silent about the hydroperoxide content in the pentenoate esters and does not give any information or indication to operate the process with a particular hydroperoxide content therein. Thus, there is no dispute between the parties that the claimed threshold of 500 ppm for the hydroperoxide content is not explicitly disclosed in that document.

3.3 The Appellant argued that hydroperoxides could not have been formed in the pentenoate esters used in the example of document (4) since the presence of oxygen was not indicated therein, with the consequence that this example was necessarily in keeping with the threshold of 500 ppm hydroperoxide.

However, the example of document (4) is simply silent about the presence or absence of oxygen and, thus, the Appellant conceded at the oral proceedings before the Board that it does not specify the absence of oxygen either. From a technical point of view the hydroformylation process of that document may be operated in the presence of hydroperoxides and at a hydroperoxide content below as well as above the threshold of 500 ppm. The specification of the patent in suit indicates in the comparative examples A, B and C on pages 7 to 9 that exceeding this threshold merely reduces the lifetime of the catalyst system, however, without preventing the hydroformylation reaction as such. Hence, the claimed threshold of 500 ppm for the hydroperoxide content in the pentenoate esters is not necessarily and automatically satisfied in the example of document (4).

3.4 Furthermore, the Appellant argued that the pentenoate esters of that example in document (4) were distilled before their use in the hydroformylation process. Due to that distillation the pentenoate esters satisfied necessarily the feature of claim 1 of having a hydroperoxide content of less than 500 ppm. In order to support his allegation the Appellant filed a test report together with the Statement of the Grounds of Appeal wherein a particular pentenoate ester mixture, after distillation, showed a hydroperoxide content of 4 ppm, i.e. below the claimed limit.

However, the Appellant's test report does not comply with the example of document (4) supposed to anticipate the subject-matter claimed. The mixtures of pentenoate esters used in the example of that document and in the test report differ substantially, in particular with respect to the main component which is 3-pentenoate and 2-pentenoate respectively, thus, rendering them incomparable. Furthermore the test report does not reveal any operation condition of the distillation thereby preventing the Board from establishing whether the particular distillation conditions indicated in the example of document (4) are met or not.

Therefore, the Appellant, when addressing the example of document (4), has merely speculated about the hydroperoxide content of less than 500 ppm in the pentenoate esters without providing substantiating facts or corroborating evidence. The burden of proving the facts it alleges lies with the party invoking these facts. If a party, whose arguments rest on these alleged facts, is unable to discharge its onus of proof, it loses thereby. In the absence of any

pertinent evidence presented by him, the Appellant has not discharged the burden of proof which is upon him, with the consequence that the Board does not accept his allegation.

3.5 According to the established jurisprudence of the Boards of Appeal a prior art document does not disclose a specific technical feature if it does not, for the skilled person, emerge clearly and unambiguously from that document. The indication of a specific technical feature in the patent in suit which is lacking in that document amounts to the addition of fresh information not provided for the skilled person by that document (see e.g. decision T 99/85, OJ EPO 1987, page 413, point 2.2 of the reasons). Applying this principle in the present case results in the conclusion that document (4) does not disclose clearly and unambiguously the use of pentenoate esters in the hydroformylation process having a hydroperoxide content of less than 500 ppm with the consequence that this document is not detrimental to the novelty of the process claimed.

3.6 To summarize, in the Board's judgement, document (4) does not anticipate the claimed invention. Therefore the Board concludes that the subject-matter of the claims is novel within the meaning of Articles 52(1) and 54 EPC.

4. *Inventive step*

4.1 The patent in suit is directed to a process for the preparation of 5-formylvalerate by hydroformylating a mixture of pentenoate esters using *inter alia* a

catalyst system comprising rhodium and an organic phosphorous ligand (claim 1).

Document (2) which is cited and acknowledged in the specification of the patent in suit on page 2, line 6 as closest prior art, describes, in particular in examples 15 and 16, such a process for preparing 5-formylvalerate by hydroformylating a mixture of pentenoate esters using a Rh/organic phosphorous catalyst.

Where the patent in suit indicates a particular piece of prior art as being closest to the claimed invention and the starting point for determining the problem underlying the patent in suit, in the present case document (2), then the Board should adopt this as the starting point for the purpose of a problem-solution analysis unless it turns out that there is closer state of the art of greater technical relevance (see e.g. decisions T 800/91, point 6 of the reasons; T 68/95, point 5.1 of the reasons).

Thus, the Board considers, in agreement with the Appellant and the Respondent, that in the present case the hydroformylation process of document (2) represents the closest state of the art and, hence, takes it as the starting point when assessing inventive step.

- 4.2 The drawbacks of that conventional hydroformylation process of pentenoate esters lie in the deactivation of the catalyst system over time. Thus, the technical problem underlying the claimed invention as indicated in the specification of the patent in suit on page 2, lines 12 to 14 and as submitted by both, the Appellant

and the Respondent, consists in maintaining the activity of the catalyst over a prolonged period of time, i.e. preventing the deactivation of the catalyst, in that hydroformylation process of pentenoate esters.

- 4.3 As the solution to this problem, the patent in suit proposes to use mixtures of pentenoate esters containing less than 500 ppm hydroperoxide compounds.

The Respondent conceded at the oral proceedings before the Board that the particular upper limit of the hydroperoxide content of 500 ppm *per se* is not essential for the proposed solution, pointing merely to a low hydroperoxide content and that it does not provide any inventive ingenuity; this threshold is, thus, disregarded when assessing inventive step (see decisions T 22/81, OJ EPO 1983, 226, points 5.1 and 7 of the reasons; T 955/93, point 3.5. of the reasons, not published in OJ EPO).

- 4.4 The Appellant never disputed that the claimed process successfully achieves the prolongation of the catalyst activity in the hydroformylation process of pentenoate esters; and the Board is not aware of any reason for challenging this finding. The specification of the patent in suit demonstrates in the examples I to III and the comparative experiments A to C on pages 7 to 9 the successful prolongation of the catalyst activity at a low hydroperoxide content in the pentenoate esters. For these reasons, the Board is satisfied that the problem underlying the patent in suit has been solved.

4.5 Finally, it remains to be decided whether or not the proposed solution to the problem underlying the patent in suit is obvious in view of the cited state of the art.

When starting from the hydroformylation process of the olefinic pentenoate esters using a Rh/organic phosphorous catalyst system known from document (2) it is a matter of course that the skilled person seeking to prolong the catalyst activity would turn his attention to that prior art in the field of hydroformylation processes using the same catalyst system. As a skilled person he would be struck by document (8) relating to a hydroformylation process of olefins using that same catalyst system and pointing to the deleterious presence of particular compounds in the olefins "which are known as catalyst poisons" (page 3, paragraph 1). In order to overcome this catalyst poisoning, which is the problem underlying the patent in suit of maintaining the catalyst activity over a longer time, that document teaches to remove the catalyst poisons from the olefins. Document (8) identifies on page 3, line 2 candidate catalyst poisons, namely sulfur, halogen, dienes, trienes or peroxides. Thus, this document indicates explicitly peroxides to be removed for preventing catalyst poisoning.

The Board concludes from the above that document (8) gives the person skilled in the art a concrete hint on how to solve the problem underlying the patent in suit to prolong the catalyst activity (cf. point 4.2 *supra*), namely by removing from the olefinic environment the peroxides poisoning the catalyst in the

hydroformylation process known from the closest prior document (2), thereby arriving at the solution proposed by the patent in suit.

Therefore, in the Board's judgement, it was obvious to try to follow the avenue indicated in the state of the art with a reasonable expectation of success without involving any inventive ingenuity. The numerical hydroperoxide content of less than 500 ppm indicated in claim 1 does not provide the claimed process with any inventive ingenuity as that range is arbitrary which finding was conceded by the Respondent (cf. point 4.3 *supra*).

4.6 For the following reasons the Board cannot accept the Respondent's arguments designed to support inventive step.

4.6.1 The Respondent argued that document (8) was directed to the hydroformylation of olefins without addressing pentenoate esters, preventing therefore the skilled person from applying its teaching to the latter.

However, on the one hand, pentenoate esters are olefinic compounds since they comprise a carbon-carbon double bond, just as olefins do and it is only that olefinic carbon-carbon double bond in the pentenoate esters and in the olefins which undergoes the hydroformylation reaction. On the other hand, document (8) specifies the "there is no particular critical limitation to the olefin to be used" (page 2, line 52) thereby making plain that the teaching of that document is not confined to any particular compound as long as

it is olefinic. Thus, the Respondent's argument cannot convince the Board.

- 4.6.2 Furthermore, the Respondent submitted that document (8) dealt with the problem of reducing low boiling components, its teaching having regard to the catalyst poisoning was merely a passing remark. Therefore the skilled person would take it into account.

The Board notes that the Respondent does not dispute that the teaching of document (8) referred to in point 4.5 *supra* with respect to the removal of peroxides as catalyst poisons is in fact comprised in that document. Pursuant to Article 56 EPC, inventive step is to be assessed "having regard to the state of the art". Thus, any teaching comprised in "the state of the art" is to be taken into account when assessing inventive step regardless of whether or not the Respondent labels that clear teaching as a "passing remark" to lessen, in his view, the importance thereof. Hence, the skilled person is not deterred from applying the teaching of document (8) referred to above to the hydroformylation process known from the closest document (2).

- 4.6.3 The Respondent brought forward that the prior art did not render the claimed subject-matter obvious since it was unknown that hydroperoxides were formed from the pentenoate esters and that those hydroperoxides were contributing to the deactivation of the catalyst, i.e. to the reduction of catalyst lifetime.

However, this argument is clearly not free of hindsight as it starts from the solution proposed by the claimed invention, namely to keep the hydroperoxide content in the pentenoate esters low. In the assessment of inventive step it is necessary to start from the closest prior art and to determine in the light thereof the problem which the invention addresses. This "problem-solution approach" ensures assessing inventive step on an objective basis without any post-facto analysis.

The drawbacks of the conventional hydroformylation process of pentenoate esters lie in the deactivation of the catalyst system over time. It is simply the technical problem of overcoming the deactivation of the catalyst over time which the skilled persons is faced with. Due to the guidance of document (8) he finds the obvious solution to this problem in removing from the olefinic environment hydroperoxides in order to maintain the activity of the catalyst over time thereby being taught at the same time that hydroperoxides are indeed a cause of the catalyst deactivation without involving any inventive merit.

4.7 Therefore, in the Board's judgement, the subject-matter of claim 1 represents an obvious solution to the problem underlying the patent in suit.

5. As a result, the Respondent's main request is not allowable as the subject-matter of claim 1 lacks inventive step pursuant to Article 56 EPC.

First and second auxiliary request

6. *Amendments (Article 123 EPC)*

The amendments made to claim 1 according to either auxiliary request are found on page 8, line 17 of the application as filed and in original claim 3, respectively and, thus, comply with the requirements of Article 123(2) EPC.

Those amendments of claim 1 as granted bring about a restriction of the scope of that claim, and therefore of the protection conferred thereby, which is in keeping with the requirements of Article 123(3) EPC.

7. *Novelty*

In view of the considerations of the Board with respect to the main request indicated in point 3 above, the Board considers the requirements of Articles 54 EPC to be satisfied with respect to either version of claim 1. This finding has been conceded by the Appellant.

8. *Inventive step*

Claim 1 according to each auxiliary request differs from claim 1 according to the main request solely in that the mixture of pentenoate esters was "containing at least 20% 3-pentenoate ester" and was "comprising cis 2-pentenoate ester", respectively.

The Respondent conceded at the oral proceedings before the Board that these amendments did not render the claimed invention more distant from the closest prior

document (2) since both fresh features were described in example 15 and example 16 of that document, respectively. With respect to the first auxiliary request the Respondent acknowledged explicitly that this amendment does not contribute to an inventive step.

Document (2) still represents the closest state of the art and the starting point in the assessment of inventive step as indicated in point 4.1 *supra*. The solution proposed by the patent in suit to the problem as defined in point 4.2 *supra* remains to be characterised exclusively by a hydroperoxide content of less than 500 ppm in the mixture of the pentenoate esters.

The considerations having regard to inventive step given in point 4.5 with respect to the main request are neither based on nor affected by the amendments made to the definition of the pentenoate ester mixtures. Therefore the conclusion drawn in point 4.7 above with regard to the main request still applies to the first and the second auxiliary request, i.e. the subject-matter of claim 1 of either auxiliary request is obvious and does not involve an inventive step.

9. In these circumstances, the Respondent's first and second auxiliary request are not allowable for lack of inventive step pursuant to Article 56 EPC as well

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:

N. Maslin

A. Nuss