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D E C I S I O N
of 10 January 1995

Case Number: T 1014/92 - 3.3.1

Application Number: 89304856.1

Publication Number: 0343819

IPC: C07C 29/16

Language of the proceedings: EN

Title of invention:
Production of alcohols

Applicant:
EXXON CHEMICAL PATENTS INC.

Opponent:
-

Headword:
Hydrofinishing/EXXON

Relevant legal provisions:
EPC Art. 56

Keyword:

"Definition of the technical problem - alleged problem not supported"
"Inventive step (no) - obvious modification of a known process"
"Time lag without long-felt-want insufficient to influence finding of obviousness"

Decisions cited:
T 0020/81, T 0109/82

Catchword:
-

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Case Number: T 1014/92 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 10 January 1995

Appellant: EXXON CHEMICAL PATENTS INC.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 8 July 1992 refusing European patent application No. 89 304 856.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. J. Nuss
Members: P. Krasa
J. A. Stephens-Ofner

Summary of Facts and Submissions

I. European patent application No. 89 304 856.1 (publication No. 343 819) was filed on 12 May 1989 with ten claims, Claim 1 of which reads:

"1. A process for the production of alcohols comprising

(i) hydroformylation of an olefine
(ii) catalytic hydrogenation of the hydroformylation product
(iii) separation of an alcohol containing fraction from the product of catalytic hydrogenation and
(iv) subjecting the alcohol containing fractions to catalytic hydrofinishing

the improvement in which comprises introducing water into the catalytic hydrofinishing stage of the process."

II. By a decision, dated 8 July 1992, the Examining Division refused the application on the ground that the claimed subject-matter was not inventive in view of the prior art acknowledged in the application in suit and document

(1) FR-A-1 023 436.

The Examining Division found, in essence, that the present process was an obvious combination of the hydrofinishing step of the prior art as acknowledged in the application in suit with the hydrogenation conditions known from document (1), thereby solving the twofold technical problem of reducing the carbonyl content in the final alcohols and to render possible the use of the less active and less selective sulphur insensitive hydrogenation catalysts.

III. An appeal was lodged against this decision and in his Statements of Grounds of Appeal the Appellant emphasised that the technical problem underlying the application in suit was to produce alcohols with the requisite standards of purity. This problem was solved by subjecting the alcohols obtained from the aldehyde hydrogenation to a hydrofinishing step with the addition of water. He argued that document (1) was not concerned with the highly sophisticated hydrofinishing step and that, therefore, it could not afford an incentive to apply the water addition disclosed for the aldehyde hydrogenation to the said hydrofinishing of alcohols. Furthermore, he submitted that the skilled person would have known from document

(3) US-A-2 809 220,

which was a development of the technology disclosed in document (1), that only a particular catalyst could be used in the hydrogenation zone together with water.

IV. In a first communication, the Board indicated that document

(2) FR-A-966 139

seemed to be representative for the state of the art as acknowledged in the application in suit and could serve as a starting point for evaluating the inventive step as it disclosed a hydrofinishing step for reducing the aldehyde content of the alcohols. Furthermore, it raised the question, whether the explanation given in citation (1) for the beneficial effect of the water addition to the hydrogenation of the aldehydes could be considered as an incentive for the skilled person to apply this feature to the hydrofinishing process known from document (2).

The Appellant replied that a skilled man would not apply results obtained from a crude reaction product to the hydrofinishing step and that, furthermore, he would have noted that according to document (1) the carbonyl content was not affected by the presence of water. Finally, the Appellant maintained that the long period of time for which the two documents (1) and (2) had been available without having been combined was a strong indication of non-obviousness of the claimed process.

In a further Communication of the Board, the Appellant's attention was drawn to the disclosure in column 2, line 30 to column 3, line 65 of document (3), relating to the addition of a controlled amount of water to the hydrogenation zone.

V. The Appellant requested (in writing) that the decision under appeal be set aside and a patent be granted on the basis of Claims 1 to 6 as submitted with the Statement of Grounds of Appeal.

VI. Oral proceedings were held on 10 January 1995, which the duly summoned Appellant, after having informed the Board accordingly, did not attend. At the end of the oral proceedings, the Chairman announced the Board's decision to dismiss the appeal.

Reasons for the Decision

1. *Amendments*

Present Claim 1 is as originally filed and the dependent Claims 2 to 6 correspond to Claims 2 to 4, 6, and 9, respectively, as originally filed. Thus, Claims 1 to 6 comply with the requirements of Article 123(2) EPC.

2. *Novelty*

The subject-matter of the claims is not disclosed in any of the citations on file and is, therefore, novel. This not being in dispute, no further comments by the Board are necessary on this issue.

3. *Problem and Solution*

3.1 The application in suit relates to a method of manufacture of alcohols with a carbonyl content of not greater than corresponding to 0.15 mg KOH/gram and a heavies content of less than 0.1 wt% from olefines by hydroformylation, catalytic hydrogenation of the hydroformylation product, and purification of the obtained crude alcohols by a catalytic hydrofinishing step (page 1, lines 1 to 3, page 3, lines 14 to 18 of the application as originally filed).

3.2 Document (2) is the only one available to the Board as representative for the state of the art as discussed in the present application. The Board considers that it discloses the closest state of the art, and therefore takes it as the starting point for evaluating inventive step. This citation discloses that purified alcohols can be obtained by catalytic hydrogenation of the crude alcohols resulting from the reduction of the hydroformylation product of olefins using either a nickel catalyst at temperatures of from 80 to 200°C, or a sulphided catalyst comprising nickel-tungsten, molybdenum etc. (page 1, left hand column, last line to line 22 of the right hand column). A temperature of 185°C is disclosed in the example of document (2) for the hydrogenation of the alcohols (i.e. the hydrofinishing) on a supported nickel-kieselguhr

catalyst and of 190°C on a sulphided nickel-tungsten catalyst (page 2, left hand column, lines 34 to 39, and right hand column, lines 8 to 11).

3.3 According to the application in suit

(i) the drawback of such a process is to be seen in the use of nickel or supported nickel catalysts which are expensive, cannot be regenerated, and are highly sensitive to the presence of sulphur, requiring a substantially sulphur-free feed (page 2, lines 5 to 17 in combination with page 3, lines 18 to 31 of the application as originally filed);

(ii) the invention claimed is also aimed at the reduction of the heavies content (i.e. content of typically dimers, such as ethers and ether-alcohols, or trimers, such as acetals; page 4, lines 1 to 5, in combination with page 3, lines 16 to 18, and page 2, line 24 to page 3, line 1 of the application as originally filed) in the resulting alcohols.

3.4 However, it has to be noted that document (2) already discloses the use of sulphur-insensitive sulphided nickel-tungsten catalyst (see point 3.2, above).

The above stated reduction of the heavies content of the products obtained according to the application in suit, vis-à-vis those resulting from the process of document (2), is, furthermore, not supported by a valid comparison. Data are given in example 1 of the application in suit for the heavies content in the products obtained by a process which otherwise is identical with that of the application in suit but in the course of which no water is added in the

hydrofinishing step. While these experiments are close to the example of document (2) in this respect, they differ from it significantly in both the hydrogenation catalyst and the hydrogenation temperature (several commercially available supported nickel catalysts without specified composition and temperatures of 90 and 110°C versus a supported nickel-kieselguhr catalyst and 185°C; and sulphided nickel/molybdenum catalysts and 140°C versus a sulphided nickel-tungsten catalyst and 190°C). Therefore, example 1 of the application in suit cannot be considered as a basis for a valid comparison of the claimed process with that of citation (2). The absence of a true comparison was also conceded by the Appellant (see the first sentence of page 2 of the submission of 17 August 1994). Therefore, the alleged advantage of a reduction of the heavies content cannot be considered as relevant to the definition of the technical problem (see T 0020/81, OJ EPO 1982, 217, in particular point 3, last paragraph of the Reasons for the Decision).

Neither can the reduction of the carbonyl content (page 6, lines 29 to 32 of the application as originally filed) be relied upon for defining the technical problem; there is no evidence available that this is indeed an advantage over the state of the art as exemplified by the process disclosed in document (2).

3.5 Therefore, in the absence of any proven advantage, the Board sees the technical problem underlying the application in suit as providing an alternative to the process known from document (2).

The solution suggested in Claim 1 consists in introducing water into the catalytic hydrofinishing step. In view of the information contained in the

application in suit, the Board is satisfied that the technical problem is credibly solved by the process of Claim 1.

4. *Inventive Step*

4.1 It remains to be decided whether or not the claimed solution involves an inventive step.

4.2 Document (1), which relates to the manufacture of (crude) alcohols from olefinic compounds essentially by carbonylation and catalytic hydrogenation of the products (page 1, left hand column), discloses that the addition of water in the hydrogenation step increases not only the selectivity in respect to the desired alcohols, but also allows for the higher hydrogenation temperatures which are required, if sulphided hydrogenation catalysts should be used (page 3, the paragraph bridging left hand and right hand column and the third paragraph of the right hand column; page 5, lines 7 to 13). Furthermore, document (1) offers an explanation for the beneficial effect of the water addition, which may suppress not only the dehydration of the desired alcohols but also the formation of acetals (page 3, right hand column, lines 5 to 8). This explanation of the influence of water on the product distribution is confirmed by document (3) (column 3, lines 48 to 65), which moreover indicates that the addition of water favours the hydrolysis over the hydrogenolysis of ether linkages (which are present in the by-products of the carbonylation reaction) and, thus, results in an increased alcohol yield.

4.3 In the Boards judgement, both documents (1) and (3) contain, therefore, a clear incentive for the skilled person to introduce water into the catalytic

hydrofinishing step known from document (2) when using a sulphided nickel-tungsten catalyst.

4.4 The Appellant's argument that a skilled person would not have applied results obtained from hydrogenating a crude alcohol from document (1) to the hydrofinishing step of document (2) in view of the different composition of the respective products to be hydrogenated is not convincing. In both cases, the desired result is the reduction of the carbonyl content which, admittedly, is lower in the starting material of the hydrofinishing step. As stated in document (1), the effect of the water addition is related to the higher reaction temperatures required with sulphided catalysts and the suppression of acetal formation and dehydration. The Board cannot see any reason, nor did the Appellant give any to that end, why these effects should be impaired by the fact that a "purer" starting material is used. That there is no essential difference in the hydrogenation of the carbonylated product and in the hydrofinishing step (as far as the hydrogenation reaction is concerned) is confirmed by document (2), which in this connection simply speaks of a "second treatment" (page 2, left hand column, lines 3 to 4).

4.5 Nor does the Board accept the Appellant's further submission either that a skilled person would have seen from document (3) that only a particular hydrogenation catalyst could be used in the presence of water, since present Claim 1 is not directed to particular catalysts (in fact it is completely silent as to the nature of the catalysts to be used) and, therefore, covers also processes applying the catalysts disclosed in document (3) as having a sufficiently rugged character to be used in a hydrogenation process in the presence of water (column 4, lines 24 to 43). It would have been

obvious for the skilled person to avail himself of the known properties of these catalysts also in the chemically closely related hydrofinishing step disclosed in Document (2).

4.6 Further, the Appellant correctly stated that a skilled person would have learned from document (1) that the presence of water in the hydrogenation zone has no influence on the (unacceptable high) carbonyl content of the hydrogenation product. This, however, cannot lessen the known other advantages of this measure as already discussed in detail. Therefore, the Board cannot accept the Appellant's contention that the skilled person, even if primarily interested in carbonyl reduction, would have paid no further attention to document (1). In view of the fact that Document (2) promises a reduction of the carbonyl content of the (crude) hydrogenation product by allowing for a second hydrogenation step and for the reasons given in points 4.2 and 4.3 above, it would have been obvious for the skilled person to try whether the addition of water would allow higher reaction temperatures and, thus, the use of sulphided catalysts without an increase of the heavies content, in this second hydrogenation step.

4.7 Nor can the Board accept the Appellant's further argument, that the long period of time (about 35 years) for which documents (1) and (2) were available to the public without having been combined is in itself cogent evidence that there was no obvious connection between them. This conclusion might only be drawn if evidence relating to time were corroborated by other evidence, such as long-felt-want, which was not adduced in the present case. In these circumstances, a finding of obviousness, based on an objective evaluation of the state of the art cannot be affected by the mere fact that two documents had not been combined by skilled

persons for a considerable period of time (see e.g. T 0109/82, OJ EPO 1984, 473, point 5.5 of the Reasons for the Decision).

5. It follows that the subject-matter of Claim 1 lacks inventive step and, thus, does not comply with the requirements of Article 56 EPC. Dependent Claims 2 to 6 fall together with independent Claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

E. Görgmaier A. Nuss