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**Datasheet for the decision
of 17 November 2010**

Case Number: T 0451/08 - 3.3.10

Application Number: 00110922.2

Publication Number: 1057803

IPC: C07C 45/50

Language of the proceedings: EN

Title of invention:

Process for producing an alcohol or an aldehyde

Patentee:

Kyowa Hakko Chemical Co., Ltd.

Opponent:

Evonik Oxeno GmbH

Headword:

Hydroformylation/KYOWA HAKKO CHEMICAL CO.

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (no) - foreseeable improvement of yield and suppression of by-products"

Decisions cited:

T 0939/92

Catchword:

-



Case Number: T 0451/08 - 3.3.10

D E C I S I O N
of the Technical Board of Appeal 3.3.10
of 17 November 2010

Appellant:
(Opponent)

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted 2 January 2008
rejecting the opposition filed against European
patent No. 1057803 pursuant to Article 102(2)
EPC 1973.

Composition of the Board:

Chairman: P. Gryczka
Members: J. Mercey
F. Blumer

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal on 29 January 2008 against the decision of the Opposition Division dated 2 January 2008 rejecting the opposition against European patent No. 1 057 803, and on 8 May 2008 filed a written statement setting out the grounds of appeal. Claim 1 of the granted patent read as follows:

"A process for producing an alcohol or an aldehyde in which a monoolefin is used as a starting material to produce a saturated aliphatic alcohol or saturated aliphatic aldehyde having one more carbon atom than the monoolefin, comprising the step of reacting the monoolefin with carbon monoxide and hydrogen in the presence of a cobalt carbonyl catalyst until the conversion of monoolefin reaches 50-90% (the first reaction step), the step of separating unreacted monoolefin from the reaction mixture obtained in the first reaction step (the step of separation of unreacted monoolefin) and the step of reacting the separated unreacted monoolefin with carbon monoxide and hydrogen in the presence of a cobalt carbonyl catalyst (the second reaction step), wherein the second reaction step is carried out in the presence of water."

II. Notice of Opposition had been filed by the Appellant requesting revocation of the patent in its entirety on the grounds of lack of inventive step (Article 100(a) EPC). *Inter alia* the following documents were submitted in opposition proceedings:

- (1) US-A-4 447 661,
- (2) GB-A-702 204,

- (3) DD-A-206 370,
- (6) *New Syntheses with Carbon Monoxide*, Springer Verlag, Berlin, 1980, pages 69 to 71,
- (7) *Ullmanns Encyklopädie der technischen Chemie*, 3. Auflage, Urban & Schwarzenberg, München-Berlin, 1962, page 71, and
- (8) *Römpf Chemie-Lexikon*, Band 4, 9. Auflage, Georg Thieme Verlag, Stuttgart, 1991, page 3178.

III. The Opposition Division held that the invention involved an inventive step starting from either document (1) or (2) as the closest prior art, since the claimed process was not suggested by either of these documents alone, nor in combination with each other, nor in combination with *inter alia* document (6).

IV. With letter dated 26 January 2009, the Respondent (Proprietor of the patent) filed auxiliary requests 1 to 3. At the oral proceedings before the Board, held on 17 November 2010, the Respondent withdrew auxiliary request 2.

Claim 1 of auxiliary request 1 differs from claim 1 of the main request (patent as granted) exclusively in that it specifies that **only** the second reaction step was carried out in the presence of water.

Claim 1 of auxiliary request 3 differs from claim 1 of auxiliary request 1 exclusively in that it specifies that water was used in the second reaction step in an amount of 0.5 to 30 wt% based on unreacted monoolefin.

V. The Appellant argued that the subject-matter of claim 1 of auxiliary request 3 was not inventive starting from document (2) as closest prior art. It submitted that document (2) disclosed all the features of claim 1, apart from the absence of water in the first reaction step, since water was formed by the reaction of the products of the hydroformylation process with each other as shown by the scheme on page 7 of the patent in suit, such that water was implicitly present in both the first and second steps of the process according to document (2). Assuming however, *in arguendo*, that the present process differed from that of document (2) by virtue of the presence of a specific amount of water in the second reaction step only, said exclusive presence of water in said step not being explicitly disclosed by document (2), it conceded that the problem solved by the patent in suit was the provision of a process for the preparation of alcohols or aldehydes from a monoolefin with increased yield and less high boiling by-products. However, document (2) itself taught that water may be optionally present in either of the two reaction steps, and *inter alia* documents (1) and (6) specifically taught that the addition of water to a hydroformylation process suppressed the formation of high boiling by-products and hereby increased the yield of the desired products. The Appellant questioned the results obtained in the experimental report which the Respondent had filed with letter dated 30 June 2005 before the Opposition Division which allegedly showed that when water was present in both reaction steps, and not only in the second step as required by claim 1 of auxiliary request 3, a poorer yield of desired products resulted than in a process according to document (2), wherein no water was present at all. Since the process

of claim 1 was merely a juxtaposition of two, possibly identical, steps, which did not interact with each other, it was not possible that water would behave differently in the two steps. The claimed process thus lacked inventive step when combining the teachings of documents (2) and (1).

VI. The Respondent submitted that the subject-matter was inventive and also started from document (2) as the closest prior art which disclosed all the features of claim 1, apart from the presence of water in an amount of 0.5 to 30 wt% based on unreacted monoolefin in the second reaction step. It argued that water was not obligatorily formed in the process according to document (2), let alone in the claimed amount, particularly when the hydroformylation process was carried out at low olefin conversions. In the light of document (2), the problem to be solved by the patent in suit was the provision of a process for the preparation of alcohols or aldehydes from a monoolefin with increased yield and producing less high boiling by-products. A comparison of Examples 1 and 2 with Comparative Examples 3 and 6, respectively, in the patent in suit showed that this problem had been successfully solved. The process was inventive, because none of the cited art taught that the presence of water in a hydroformylation process led to improved yields of alcohols and/or aldehydes. Furthermore, although certain documents taught the addition of water to suppress high boiling by-product formation, none taught that such an improvement could be achieved by adding water to the second reaction step, document (1) teaching addition of water to the first step only and document (6) not even describing a two step

hydroformylation process. Indeed documents (3) and (6) taught away from the present invention, since water was described therein as having a negative effect upon the reaction. In any case, a reduction in high-boiling by-products did not automatically correspond to an increase in the yield of alcohols or aldehydes, particularly at low conversions. Furthermore, documents (7) and (8) taught other methods for reducing the amount of by-products of a hydroformylation process, so that the skilled person had no incentive to specifically select the addition of water to solve the problem posed. The Respondent also argued that the experimental report which it had filed before the Opposition Division showed that the invention was not an arbitrary choice from within document (2), since it was surprising that the positive effects of water were achieved only when it was present in the second step and not when present in both steps. Thus, the skilled person would not have arrived at the claimed process without exercising inventive ingenuity.

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, or subsidiarily, that the patent be maintained on the basis of auxiliary requests 1 or 3, both submitted with letter dated 26 January 2009.

VIII. At the end of the oral proceedings, the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

Main request and auxiliary requests 1 and 3

2. Independent claim 1 of auxiliary request 3 is directed to an embodiment of the main request and of auxiliary request 1, namely to the embodiment wherein water is used in the second reaction step only and in an amount of 0.5 to 30 wt% based on unreacted monoolefin. In case this embodiment according to auxiliary request 3 lacked inventive step, such a line of requests would mandatorily result in the conclusion that the subject-matter of the main request and of auxiliary request 1, which embrace this obvious embodiment, cannot involve an inventive step either. For this reason, it is appropriate that the subject-matter of claim 1 of auxiliary request 3 is examined first as to its inventive ingenuity.

3. *Amendments (Article 123(2) and (3) EPC)*

Claim 1 is based on original claims 1, 2 and 8. The amendments made to the claim were not objected to by the Appellant, nor does the Board see any reason to question their allowability under Article 123(2) and (3) EPC of its own motion.

4. *Inventive step*

- 4.1.1 The patent in suit is directed to a two-step hydroformylation process using a cobalt carbonyl catalyst. A similar process already belongs to the

state of the art, namely to the disclosure of document (2). The Board considers, in agreement with both parties, that the disclosure of document (2) represents the closest state of the art and, hence, takes it as the starting point when assessing inventive step.

4.1.2 Document (2) discloses a process for producing *inter alia* alcohols (see claims 1, 2, 6, 8 and 9), which comprises reacting olefinically unsaturated compounds, such as the monoolefin diisobutylene (see Example 2), with carbon monoxide and hydrogen in the presence of a cobalt carbonyl catalyst whilst maintaining the conversion of the olefin in this first reaction step within the range 30 to 70%, separating the oxygenated products from the reaction mixture and then reacting olefinically unsaturated compounds which were unreacted in the first reaction step with carbon monoxide and hydrogen in the presence of a cobalt carbonyl catalyst in a second reaction step. Both steps may be carried out in the presence or absence of water (see page 7, lines 53 to 58 and 67 to 68). Both parties were in agreement with this analysis.

4.1.3 The Appellant, however, was of the opinion that water was obligatorily present in both reaction steps of document (2), since water was formed by the reaction of the products of the hydroformylation reaction with each other. This was shown by the scheme on page 7 of the patent in suit, which is a reaction scheme illustrating how the various by-products of such a hydroformylation process are formed, the reaction of an aldehyde with an alcohol resulting in the formation of acetal and water.

However, the question of whether water is implicitly present in the hydroformylation steps of document (2) can be left open, since even when it is assumed that water is absent in both steps of the process of document (2), the Board nevertheless arrives at the negative conclusion that the claimed process lacks inventive step, as set out below.

- 4.2 The technical problem underlying the patent in suit as formulated by the Respondent is the provision of a process for the preparation of alcohols or aldehydes from a monoolefin with increased yield and producing less high boiling by-products (see patent specification, paragraph [0009]).
- 4.3 As the solution to this problem, the patent in suit proposes the process according to claim 1 of auxiliary request 3, characterised by the presence of water in an amount of 0.5 to 30 wt% based on unreacted monoolefin in the second reaction step only.
- 4.4 A comparison of Examples 1 and 2 with Comparative Examples 3 and 6, respectively, in the patent in suit shows that the presence of such an amount of water in the second step leads to increased yields of alcohols or aldehydes and less high boiling by-products such that it is credible that the problem underlying the patent in suit has been successfully solved. The Appellant did not contest this finding.
- 4.5 Finally, it remains to be decided whether or not the proposed solution to the objective problem underlying the patent in suit is obvious in view of the state of the art.

4.5.1 Document (1), which is also concerned with the preparation of alcohols and/or aldehydes by a two step hydroformylation of monoolefins in the presence of a cobalt carbonyl catalyst (see claims 1 and 8) specifically teaches that in order to suppress the formation of high boiling products, such as acetals (see col. 1, lines 34 to 39), water in an amount of from 2 to 10% by weight based on the olefin should be added to the reaction system (see col. 4, lines 7 to 11; claims 6 and 7). Thus, the person skilled in the art, following the avenue indicated in the state of the art, would incorporate the addition of water in the specified amount from document (1) into the process of document (2) with the expectation of obtaining less high boiling by-products, without exercising any inventive ingenuity. The skilled person would thereby also expect higher yields of the desired alcohol or aldehyde products, since the undesired high boiling by-products, such as acetals, are formed by the reaction of these two desired products with each other as shown by the scheme on page 7 of the patent in suit, such that in the present case, a reduction in the formation of such high boiling by-products does indeed automatically correspond to an increase in the yield of alcohols and/or aldehydes. The claimed process thus lacks inventive step when combining the teaching of document (2) with that of document (1).

4.6 For the following reasons, the Board is not convinced by the Respondent's submissions in support of the presence of an inventive step.

4.6.1 The Respondent argued that documents (3) and (6) taught away from the present invention, since water was described therein as having a negative effect upon the reaction.

However, document (3) teaches only when describing a prior art process that the addition of water led to a reduction in the rate constant of the hydroformylation process, but describes no effect on the yield or the amount of by-products. In addition, document (3) teaches that water can be added in certain amounts without causing a detrimental effect, with the consequence that the skilled person would not be discouraged by said document from carrying out a hydroformylation process in the presence of water in order to increase the yield and reduce by-products. With regard to the disadvantages of water referred to in document (6), these are only present when water is used as a solvent (see page 71, line 1), Table 1.21 on page 70 teaching that when used as an additive, as is the case of the present invention, water improves both the activity and selectivity of the hydroformylation process. Thus document (6) also does not teach away from carrying out a hydroformylation process in the presence of water. These arguments must thus be rejected.

4.6.2 The Respondent also argued that in view of the fact that other methods were described in the prior art in order to suppress the formation of by-products in a hydroformylation process, namely by reducing the olefin conversion (see document (7)) or by performing a retro-oxo-synthesis on the undesired 2-methylpropanal (see document (8)), the skilled person had no incentive to

specifically select the addition of water to solve the problem posed.

However, the fact that the skilled person had several alternatives at his disposition when looking for a method of improving the yield and reducing the by-products of a hydroformylation process has no impact on the assessment of obviousness, since a mere choice from a host of possible solutions does not in itself involve inventive ingenuity (see decision T 939/92, OJ EPO 1996, 309, points 2.5.2 and 2.5.3 of the reasons).

- 4.6.3 The Respondent argued that none of the cited documents taught that the desired improvement to the hydroformylation process could be achieved by adding water to the second reaction step only, document (1) teaching addition of water to the first step only.

However, apart from the presence of water and the reaction scale, the two steps of the hydroformylation process of the patent in suit may be chemically identical, no olefin conversion being specified in the second step, such that it may be the same as in the first step. Thus the first and second steps do not necessarily interact and are thereby merely an aggregation of steps, i.e. two hydroformylation reactions carried out in series. The skilled person would thus expect the teaching of the prior art that high boiling by-products of a hydroformylation process may be lowered and the yield increased by the addition of water to be applicable to any step of a multistep hydroformylation process. Since the reaction conditions of the first step of document (1) (see claim 1(a)) fall under those of the second step of the process of the

patent in suit, the skilled person would have expected that the addition of water to this second step would also lead to the improvements, namely reduction in high boiling products, described in document (1). This argument must thus also be rejected.

- 4.6.4 Finally, the Respondent argued that it was surprising that the positive effects of water were achieved only when it was present in the second step and not when present in both steps. More particularly, a process in which water was added only to the second step (Example 2 of the patent in suit) resulted in a higher yield of aldehyde and alcohol than when water was added to both steps (Process B of the experimental report filed with letter dated 30 June 2005), which, in turn, resulted in a lower yield than when water was not added at all (Comparative Example 6 of the patent in suit).

However, a comparison of Example 2 with Process B and Comparative Example 6 is not suitable for showing that only when water is exclusively present in the second step does it have a positive effect with respect to yield, whereas when it is present in both steps (and by implication in the first step only), it has a negative effect. This is because in each of these examples, the two steps are carried out under different reaction conditions, most particularly under different olefin conversions (72% and 95% in the first and second steps respectively), said different conditions, however, not being reflected in claim 1 of the patent in suit. As such, the different effect of water in each step cannot be attributed merely to its presence only in the second as opposed to the first or both steps, but also to the different reaction conditions under which these steps

are carried out. This argument must therefore also be rejected.

4.7 For these reasons, the subject-matter of claim 1 of auxiliary request 3 is not allowable for lack of inventive step pursuant to Article 56 EPC.

4.8 In these circumstances, since the process of claim 1 of auxiliary request 3 is encompassed by claim 1 of the main request and of auxiliary request 1 (see point 2 above), the main request and auxiliary request 1 share the fate of auxiliary request 3 in that they too are not allowable for lack of inventive step pursuant to 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:

C. Rodríguez Rodríguez

P. Gryczka