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DECISION
of 12 October 2004

Case Number: T 0808/00 - 3.3.1

Application Number: 93115384.5

Publication Number: 0589463

IPC: C07C 45/50

Language of the proceedings: EN

Title of invention:

A method of controlling a hydroformylation reaction

Patentee:

Mitsubishi Chemical Corporation

Opponents:

Celanese Chemicals Europe GmbH

Union Carbide Corporation

BASF Aktiengesellschaft Patente, Marken und Lizenzen

Headword:

Hydraformylation/MITSUBISHI

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty (yes) - no implicit disclosure"

"Inventive step (yes) - non-obvious alternative process"

Decisions cited:

T 0020/81, T 0651/91, T 0071/93, T 0355/97

Catchword:

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Case Number: T 0808/00 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 12 October 2004

Appellant I:
(Opponent 1)

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(Opponent 2)

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Party as of right:
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-

Respondent: Mitsubishi Chemical Corporation
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted 8 June 2000
rejecting the opposition filed against European
patent No. 0589463 pursuant to Article 102(2)
EPC.**

Composition of the Board:

Chairman: R. Freimuth
Members: J. M. Jonk
S. C. Perryman

Summary of Facts and Submissions

I. Appellants 1 and 2 (Opponents 1 and 2) lodged an appeal against the decision of the Opposition Division rejecting the opposition against the European patent No. 0 589 463 (European patent application No. 93 115 384.5), the independent Claim 1 reading as follows:

"A method for producing aldehydes by subjecting an olefin, a feed oxo gas containing hydrogen and carbon monoxide, and a recycled gas withdrawn from a reactor and returned to the reactor, to a hydroformylation reaction in the reactor in the presence of a catalyst, which comprises the steps of:

providing an operation unit for adjusting a flow rate of the feed oxo gas supplied to the reactor or a flow rate of a discharge gas from the reactor;

setting out a target value for the partial pressure of carbon monoxide in the reaction system to obtain aldehydes with a desired production ratio of normal aldehyde to isoaldehyde;

detecting the partial pressure of carbon monoxide corresponding to the target value;

determining an operational amount of the operation unit required to maintain the detected partial pressure of carbon monoxide at the target value based on a deviation of the detected partial pressure of carbon monoxide from the target value; and

adjusting the flow rate of the feed oxo gas or the flow rate of the discharge gas based on the operational amount."

II. The opposition was filed against the patent as a whole, and based on the grounds of lack of novelty and lack of inventive step as indicated in Article 100(a) EPC. It was supported by several documents including:

(1) SU-A-1 555 323 (English translation), and

(2) US-A-4 247 486.

III. The Opposition Division held that the subject-matter of the patent in suit was novel and also involved an inventive step. In this context, it held in particular that by adjusting the total pressure of the reaction system less violent changes in the CO partial pressure were achieved than by directly altering the composition of the oxo gas as disclosed in documents (1) and (2). It was therefore easier to maintain a steady CO partial pressure at the required value. Thus, neither document (1) nor document (2) disclosed or suggested the process of the patent in suit as claimed.

IV. Oral proceedings before the Board were held on 12 October 2004. Appellant 2 and Opponent 3 as a party as of right according to Article 107 EPC, who had been duly summoned, did not attend the oral proceedings.

V. Appellant 1 objected to the process of Claim 1 of the patent in suit exclusively with respect to novelty and inventive step.

He based his novelty objection solely on document (1). Although said document was silent with respect to the further processing of the purge gas, it implicitly disclosed its recycling to the reactor, since this embodiment represented a selection within only two known alternatives, namely recycling or disposal. Furthermore, said document also disclosed adjusting of the flow rate of the oxo gas based on the operational amount to maintain the detected partial pressure of carbon monoxide at its target value if there were no need to modify the composition of the feed oxo gas.

Concerning inventive step, he considered that document (1) was the closest prior art. He disputed that the technical problem underlying the patent in suit in view of this document was the provision of a method of controlling a hydroformylation having an improvement with respect to the control of the partial pressure of CO in the reactor. Instead, the technical problem underlying the patent in suit was only the provision of an alternative process. The solution of this technical problem as claimed in the patent in suit, if considered novel, was obvious to the skilled person in view of document (1) and/or document (2). In this context, he emphasised that document (1) disclosed a control of the flow rate of oxo gas feed making use of a signal from a transducer for the concentration of carbon monoxide, that document (2) disclosed the necessity of controlling the partial pressure of the carbon monoxide in the reactor in order to achieve a desired normal/iso aldehydic product isomer ratio, and that recirculation of reaction gas into the reactor was well known in the art, e.g. from document (2).

VI. Appellant 2 submitted in writing that the process of the patent in suit as claimed lacked novelty in view of document (2), since the process of this document necessarily comprised a detection of the CO partial pressure in the reaction system and an adjustment of the CO partial pressure in order to maintain a desired level by altering the feed flow of the oxo gas.

VII. The Respondent argued that the subject-matter of the patent in suit was novel and involved inventive step. He emphasised that the cited documents did not disclose a process comprising an adjustment of the desired CO partial pressure by altering the flow rate of the oxo gas or the purge gas flow amount based on an operational amount determined by the deviation of a detected partial pressure of CO and the target value thereof. In fact, document (1) disclosed a control of the composition of the oxo gas feed by way of a controlling unit making use of a signal from a transducer for the concentration of carbon monoxide in combination with several signals from additional transducers and a control of the flow rate of the oxo gas having the desired composition by way of another controlling unit making use of transducers for the flow rate of propylene and the flow rate of the oxo gas to the reactor. Furthermore, document (2) did not disclose any way of controlling the desired partial pressure in the reactor.

VIII. The Appellants (Appellant 2 in writing) requested that the decision under appeal be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed.

IX. At the conclusion of the oral proceedings the Board's decision was pronounced.

Reasons for the Decision

1. The appeal is admissible.
2. Having regard to the grounds of opposition, the decision under appeal and the submissions of the parties to the proceedings, the only substantial issues to be dealt with are whether the claimed subject-matter is novel and involves inventive step in the light of the cited documents (1) and (2).
3. *Novelty*
 - 3.1 Concerning the issue of novelty, the Board firstly observes that according to the established jurisprudence for concluding lack of novelty, there must be a direct and unambiguous teaching in a prior art document, which would inevitably lead the skilled person to something falling within the scope of what is claimed. In this context, the Boards of Appeal found that a generic disclosure or a disclosure leaving open the choice between two or more alternatives did not take away the novelty of any specific feature falling within that disclosure (see e.g. T 651/91, in particular point 4.3 of the Reasons).
 - 3.2 Document (1) discloses a process for producing aldehydes by subjecting an olefin, a feed oxo gas containing carbon monoxide and hydrogen in the presence

of a catalyst to a hydroformylation reaction in a reaction zone leaving it open whether or not a purge gas withdrawn from a separator (3) is recycled to the reaction zone.

The novelty objection of Appellant 1 was based on the contention that said document (1) implicitly disclosed a recycling of the purge gas to the reactor zone, since this process feature represented a selection within only two known alternatives, namely recycling or disposal.

However, apart from the fact that a restriction of the further processing or use of the purge gas to the alleged two alternatives is considered speculative, the Board finds, in line with the established jurisprudence of the Boards of Appeal indicated above, that this novelty objection fails, since document (1) does not directly and unambiguously disclose as a technical teaching the recycling of the purge gas to the reactor zone. In this context, the Board notes that even if it were generally known that recycling of the purge gas to the reaction zone would be favourable, this feature cannot be considered implicitly disclosed, since it is not directly derivable from document (1) itself (see also T 71/93, point 4.1.1 of the Reasons).

- 3.3 Document (2) discloses, as does document (1), a process for producing aldehydes by subjecting an olefin, a feed oxo gas containing hydrogen and carbon monoxide in the presence of a catalyst to a hydroformylation reaction. In addition, it discloses recycling of a purge gas to the reaction zone. Moreover, it is indicated in this document that the partial pressure of carbon monoxide

in the reactor is an important factor in the process in order to achieve a desired normal/iso aldehydic product isomer ratio and should be kept within a certain range (see column 6, lines 53 to 68, and column 7, lines 5 to 10).

Appellant 2 argued lack of novelty by contending that in order to control the partial pressure of carbon monoxide in the reactor the process of this document necessarily comprised a detection of the CO partial pressure in the reaction system and an appropriate adjustment of the CO partial pressure to a target value by altering the feed flow of the oxo gas.

However, said document (2) does not comprise any teaching how to maintain a certain level of the partial pressure of the carbon monoxide in the reactor and, consequently, it does not comprise a direct and unambiguous disclosure inevitably leading the skilled person to something falling within the scope of what is claimed in the patent in suit either.

3.4 In these circumstances, the Board concludes that the claimed subject-matter of the patent in suit is novel over the cited documents.

4. *Inventive step*

4.1 For deciding whether or not a claimed invention meets this criterion, the Boards of Appeal consistently apply the problem and solution approach, which essentially involves identifying the closest prior art, determining in the light thereof the technical problem which the claimed invention addresses and successfully solves,

and examining whether or not the claimed solution to this problem is obvious for the skilled person in view of the state of the art.

If the technical results of the claimed invention provide some improvement over the closest prior art, the problem can be seen as providing such improvement, provided this improvement necessarily results from the claimed features for all that is claimed. If, however, there is no improvement, but the means of implementation are merely different, the technical problem can be defined as the provision of an alternative to the closest prior art.

- 4.2 The Board considers, in agreement with the parties to the proceedings, that the closest prior art with respect to the compositions according to Claim 1 of the patent in suit is the disclosure of document (1).

This document relates to a process for producing butyraldehyde by subjecting propylene, a feed oxo gas containing carbon monoxide and hydrogen in the presence of a catalyst to a hydroformylation reaction.

In order to reduce the specific flow rate of propylene and to increase the productivity with respect to the n-butyraldehyde isomer, the process is carried out by stabilising the temperature in the reaction zone and the proportions of the initial propylene and synthesis gas fed into the reactor, and controlled by stabilising the concentration of catalyst at the input to the reactor and varying the proportions of hydrogen and carbon monoxide - the constituents of the synthesis gas entering the reactor - as a function of the

concentration of carbon monoxide in the gases emerging from the high-pressure separator (see page 1, lines 13 to 29).

In particular, it discloses by referring to the Figure:

(a) that signals from transducers (16) and (18) for the flow rate of propylene and the flow rate of the synthesis gas are transmitted to the input of a block (28) for controlling a valve (29) for supplying synthesis gas maintaining the ratio of propylene: synthesis gas at a given level (see page 3, lines 6 to 9, and page 2, lines 18 to 20),

and

(b) that the composition of the initial synthesis gas is formed from a (so called) converted gas comprising carbon monoxide and hydrogen by mixing a first flow passing valve (32) and having the same composition as the supplied converted gas and a second flow (indicated as recycling flow) having a modified composition compared to that of the supplied converted gas due to the separation of hydrogen in a fractionation block (33), whereby:

(i) signals from transducers (19) and (20) for the flow rate of said second flow and the supplied converted gas,

(ii) signals from transducers (22) and (23) for the composition of said second flow and the composition of the supplied converted gas,
and

(iii) a signal from a transducer (24) for the concentration of carbon monoxide in the gas of the high-pressure separator (3)

are transmitted to a block (30), where calculations are made on the basis of a deviation of the value of the concentration of the carbon monoxide in the high-pressure separator (3) from a given value in combination with the other detected values to assess a magnitude of correction for setting a controller (31) determining the mixing ratio of said first and said second gas flow by means of the valve (32) (see in particular page 3, lines 10 to 25).

4.3 Regarding this prior art, the Respondent submitted that the technical problem to be solved was to provide a method of controlling a hydroformylation reaction wherein the control of the partial pressure of carbon monoxide in the reactor is facilitated, and accordingly, the production ratio of n-aldehyde to iso-aldehyde can easily be controlled to a desired level (see also page 2, lines 55 to 58, of the patent in suit).

4.4 However, in accordance with the established jurisprudence of the Boards of Appeal, only such improvements can be recognised for defining the technical problem underlying the patent in suit which are actually achieved by substantially all the embodiments encompassed within the scope of the claim.

4.5 In this context, it follows from Example 1 and Figure 5 of the patent in suit, that under the process

conditions of this example the target value of the partial pressure of carbon monoxide, and consequently a desired production ratio of n- to iso-aldehyde, could not be consistently achieved.

4.6 Thus, having regard to said example, and in the absence of sufficient proof for any improvement over the process of document (1), the Board finds that it is not credible that the alleged improvement can be realised by substantially all the embodiments encompassed within the scope of present Claim 1, and that consequently a reformulation of the technical problem as defined by the Respondent becomes necessary to meet a less ambitious objective (see e.g. T 20/81, OJ EPO 1982, 217, point 3 of the reasons; and T 355/97 (not published in the OJ EPO), point 2.6 of the reasons).

4.7 In these circumstances, the technical problem underlying the patent in suit in the light of the closest state of the art can only be seen in the provision of an alternative process for controlling a hydroformylation reaction comprising an easy control of the partial pressure of carbon monoxide and, consequently, an easy control of the production ratio of n-aldehyde to iso-aldehyde.

4.8 The patent in suit suggests as the solution to this problem, a process according to Claim 1 essentially comprising:

- (a) setting out a target value for the partial pressure of carbon monoxide in the reaction system,

- (b) detecting the partial pressure of the carbon monoxide,
- (c) determining an operational amount of an operation unit required to maintain the detected partial pressure of carbon monoxide at the target value based on a deviation of the detected value from the target value, and
- (d) adjusting the flow rate of the feed oxo gas or the flow rate of the discharge gas on the basis of said operational amount.

In view of the technical information in the patent in suit, in particular in the examples, the Board is satisfied that the problem as defined in point 4.7 above has been solved. This was never challenged by the Respondents.

4.9 The remaining question is thus whether the prior art as a whole has suggested to a person skilled in the art solving the technical problem indicated in point 4.7 above in the proposed way.

4.10 In this context, and in view of the above defined technical problem, Appellant 1 in challenging the inventive step only relied on documents (1) and (2).

4.11 As indicated under points 3.2 and 4.2 above, document (1) cannot render the claimed subject-matter obvious by itself since, apart from the fact that it is silent about a recycling of the purge gas flow and about an adjustment of the flow rate of the discharge gas (one of the two alternative embodiments of the process

claimed), it discloses the control of the carbon monoxide concentration in the reactor by a combination of controlling the flow rate of the initial synthesis gas by valve (29) on the basis of the detected flow rates of propylene and synthesis gas and the composition of the initial synthesis gas by valve (32) on the basis of the detected concentration of the carbon monoxide in the high-pressure separator (3) the other detected flow rates and compositions. In contrast thereto, according to the process of patent in suit only the flow rate of the oxo gas or the flow rate of the discharge gas is adjusted.

Furthermore, as indicated under point 3.3 above, document (2) does not comprise any teaching how to maintain a certain level of the partial pressure of the carbon monoxide in the reactor. In fact, a skilled person could only derive from the example in document (2) that, under the specific reaction conditions applied therein, the level of the partial pressure of the carbon monoxide in the reactor might be maintained by applying a synthesis gas feed having a particular composition (see Table 2).

Therefore, documents (1) and (2), taken alone or in combination, do not provide an incentive to the skilled person to arrive at the claimed solution of the above defined technical problem, which solution essentially comprises the adjustment of the flow rate of the feed oxo gas or the flow rate of the discharge gas solely on the basis of the deviation of a detected value of the partial pressure from the target value.

5. In conclusion, the Board finds that the subject-matter of present Claim 1 involves an inventive step in the sense of Article 56 EPC.

Dependent Claims 2 to 8 relate to particular embodiments of the subject-matter of Claim 1. They are therefore also allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

A. Townend

R. Freimuth