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Datasheet for the decision of 27 February 2008

Case Number: T 0100/06 - 3.3.10

Application Number: 99124566.3

Publication Number: 1008580

IPC: C07C 45/50

Language of the proceedings: EN

Title of invention:
Process for preparing aldehydes and alcohols

Patentee:
Mitsubishi Chemical Corporation

Opponent:
THE DOW CHEMICAL COMPANY

Headword:
Mitsubishi/DOW

Relevant legal provisions:
EPC Art. 56, 84, 111(1), 123

Keyword:
"Amendments (allowable) no added matter - clear"
"Inventive step (yes) - solution not obvious"

Decisions cited:
G 0009/91, T 0301/87

Catchword:
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Case Number: T 0100/06 **-** 3.3.10

D E C I S I O N
of the Technical Board of Appeal 3.3.10
of 27 February 2008

Appellant: (Opponent)
THE DOW CHEMICAL COMPANY
2030 Dow Center
Midland
Michigan 48674 (US)

Representative:
Goldener, Beatrice
c/o Dow International Holdings S.A.
Bachtobelstrasse 3
CH-8810 Horgen (CH)

Respondent: (Patent Proprietor)
Mitsubishi Chemical Corporation
14-1, Shiba 4-chome
Minato-ku
Tokyo 108-0014 (JP)

Representative:
Hollatz, Christian
TER MEER STEINMEISTER & PARTNER GbR
Patentanwälte
Mauerkircherstrasse 45
D-81679 München (DE)

Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 23 November 2005 concerning maintenance of European patent No. 1008580 in amended form.**

Composition of the Board:

Chairman: R. Freimuth
Members: C. Komenda
D. S. Rogers

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal on 23 January 2006 against the interlocutory decision of the Opposition Division posted 23 November 2005, which found that the European patent No. 1 008 580 in its amended form met the requirements of the EPC.

II. Notice of opposition had been filed by the Appellant requesting revocation of the patent as granted in its entirety on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC), based *inter alia* on the following documents:

(1) US-A-4 533 755 and
(5) Kirk-Othmer, Encyclopedia of Chemical Technology, 4th Ed., 17,902-919 (1996).

III. The decision under appeal was based on an amended set of claims 1 to 14 according to the then pending Auxiliary Request 1, independent claim 1 of which read as follows:

"1. A process for preparing aldehydes which comprises reacting an olefinic unsaturated compound with hydrogen and carbon monoxide by hydroformylation reaction in the presence of a catalyst in a continuous multistage flow reactor, wherein the reaction starting material of liquid phase is transferred from an upper reactor to a lower reactor of the multistage flow reactor, wherein the continuous multistage flow reactor contains n number ($n \geq 2$) of flow reactors, and the reaction is carried out in the presence of pressure sectional zones satisfying the following pressure condition (2)

provided that partial pressures of hydrogen in each reactor are illustrated as ($P_{H2}(1)$), ($P_{H2}(2)$), ... ($P_{H2}(n)$) in order from the upper stream from the reactor,

(2) $P_{H2}(m-1) < P_{H2}(m)$

in which m is an integer in the range of $2 \leq m \leq n$, wherein the reaction is carried out in a pressure sectional zone in which B/A is from 1.2 to 10, provided that among hydrogen partial pressures of n number of reactors, the lowest partial pressure value is A and the highest partial pressure value is B."

The Opposition Division held that the amendments made to the claims according to the then pending Auxiliary Request 1 satisfied the requirements of Articles 123 and 84 EPC. The claimed subject-matter was regarded as being novel over the cited prior art and as involving an inventive step in view of the prior art documents (1) and (5), since these documents gave no incentive to operate the process at a ratio of B/A from 1.2 to 10 and to effect a transfer of liquid reaction starting material.

IV. Annexed to the statement of the Grounds of Appeal dated 7 March 2006 the Appellant submitted for the first time documents (5a) and (6):

(5a) "Oxo Process" by E. Billig and D.R. Bryant, Kirk-Othmer Encyclopedia of Chemical Technology, 8 1996 by John Wiley & Sons Inc.,

(6) GB-A-1 387 657.

Document (5a) is the complete text on the Oxo Process of which an extract was submitted as document (5) during the opposition procedure. In addition the Appellant also submitted for the first time documents (5b) and (5c), these being enlarged figures 2 and 3 respectively from document (5).

V. The Appellant submitted that the requirements of Articles 84 and 123 EPC were not fulfilled with regard to the amendments made. The terms "upper reactor" and "lower reactor" were unclear, since in paragraph [0050] of the specification of the patent in suit the terms "upper" and "lower" indicated a position or altitude and, thus, could not be interpreted as relating to an "upstream reactor" or "downstream reactor". He further stated that there was no substantive support for the feature that "the reaction starting material of liquid phase" was transferred from the upper to the lower reactor, since the specification of the patent in suit clearly distinguishes in paragraph [0051] between a "starting material", which had not yet been in contact with the reactant, and a "reaction solution", which was transferred to another reactor. Further, he stated that the amendment did not fulfil the requirements of Article 123(2) EPC, since the passage in paragraph [0020] of the specification of the patent in suit used the definite article, whereas in claim 1 the indefinite article was used.

In view of inventive step the Appellant argued that the process claimed according to the patent in suit was obvious from document (6) alone, or from a combination of documents (1) and (5a). Document (6) disclosed all the technical features of the process of the patent in

suit apart from the claimed ratio of B/A, which was regarded as being an arbitrary modification. Since document (6) taught that carbon monoxide and hydrogen had to be supplied before the secondary reaction zone, which was operated at higher pressure, this was regarded as being a clear hint for the skilled person to use a higher hydrogen partial pressure in the second reaction zone, thereby arriving at higher B/A ratios. In his second line of argumentation the Appellant started from document (1), which disclosed all the technical features of the claimed process, including overlapping values of B/A as calculated from the pressure values given in the description, but did not disclose the step of transferring liquid material between the two reactors. From document (5a), Fig. 2 and 3, which related to the commercial oxo process, the skilled person got the incentive to transfer liquid phase material from the first to the second reactor. Further, Fig.3 of document (5a) was very similar to the Fig. 1 of the specification of the patent in suit, which was an indication that the same process steps were used.

VI. With the reply to the statement of the Grounds for Appeal the Respondent submitted a main request and auxiliary requests 1 to 3. The main request corresponded to the auxiliary request 1 on which the decision under appeal was based. Auxiliary requests 1 and 2 corresponded to auxiliary requests 2 and 3 as submitted during opposition proceedings, auxiliary request 3 was a combination of claim 1 according to the main request and granted claims 4 and 5.

VII. The Respondent contested the argumentation of the Appellant and requested in writing that documents (5a) and (6) be not admitted into the appeal proceedings, as they were late filed. During the oral proceedings before the Board the Respondent withdrew this objection. The Respondent pointed out that the features "upper reactor" and "lower reactor" in claim 1 were recognized and clear terms in the art and related to "upstream" and "downstream" reactors. As support he referred to paragraph [0011] of the specification of the patent in suit, as well as to the wording of claim 1, which indicated that the hydrogen partial pressures were adjusted "in order from the upper stream of the reactor". The passage cited by the Appellant in paragraph [0050] of the specification of the patent in suit related to different parts of the respective reactors and were irrelevant for the understanding of the expressions "upper reactor" and "lower reactor". Concerning the meaning of the feature "reaction starting material of liquid phase" the Respondent stated that this clearly indicated that from the upstream reactor a liquid reaction mixture still containing unreacted starting material was transferred to the downstream reactor. The argument of the Appellant would technically make no sense, since it would require the transfer of unreacted starting material through the whole multistage flow reactor without any reaction at all. Concerning the objection under Article 123 EPC, the Respondent argued that the passage introduced into claim 1 was fully supported by the wording of page 7, lines 13 to 15 of the application as filed. The change of the article did not result in a change of subject-matter, but constituted merely a necessary editorial amendment.

For inventive step the Respondent regarded document (1) as closest prior art. Starting from this document the problem to be solved was to provide an improved hydroformulation process achieving both high conversion of the olefin and high selectivity. The solution to this problem was to select a higher hydrogen partial pressure in the downstream reactors, to select a ratio of B/A within the range of 1.2 to 10 and to transfer reaction starting material of liquid phase to the downstream reactors. Document (5), which described a wide variety of influences on commercial hydroformulation processes, did not disclose the transfer of liquid reaction starting material. Figure 3 related to a product recycle process, which was a different process. Further, the schematic figures did not give technical information on how the process was operated. Document (6) differed from the claimed process in that it did not disclose the ratio of B/A, referred only to absolute pressures in general, did not use a continuous multistage flow reactor and disclosed only an exchange of liquid catalyst solution between a primary and a secondary reactor. As the process described in this document focussed on avoiding the build-up of inert gases and the loss of unreacted olefin, the Respondent concluded, that the document was further away than document (1).

VIII. With a fax letter dated 4 January 2008 the Appellant withdrew his request for oral proceedings and announced that he would not be present at the oral proceedings before the Board.

IX. The Appellant requested in writing 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 the sets of claims according to auxiliary requests 1 to 3, submitted with a letter dated 21 July 2006.

X. At the end of the oral proceedings held on 27 February 2008, the decision of the Board was announced.

Reasons for the Decision

1. *The appeal is admissible.*

Main request

2. *Amendments*

According to Article 111(1) EPC, the Board may exercise any power within the competence of the department that was responsible for the decision - in this case the Opposition Division. In accordance with the established jurisprudence of the Boards of Appeal, the Board has the power to examine whether the patent satisfies all requirements under the EPC, as long as the objections arise out of the amendments made thereto. That examination requires the Board to consider whether or not those amendments introduce any contravention of any requirement of the EPC, including Articles 84 and 123 EPC (see decisions T 301/87, OJ EPO 1990, 335, point 3.8 of the reasons; G 9/91, OJ EPO 1993, 408,

point 19 of the reasons). Therefore the Board must examine whether or not these amendments are in keeping with the requirements of Articles 84 and 123 EPC.

2.1 *Article 123(2) EPC*

In the present case, the feature "the reaction starting material of liquid phase is transferred from an upper reactor to a lower reactor" (***emphasis added***) has been incorporated into claim 1. Support for this feature is to be found with almost identical wording on page 7, lines 13 to 15 of the application as filed.

The only difference to the wording of the original application as identified by the Appellant is the change from the definite article "the" to the indefinite article "a" of the upper/lower reactor. In the absence of any arguments of the Appellant, as to why the change of the article resulted in a change of subject-matter, the Board considers the definite article used on page 7 of the original application as referring to the respective upper and lower reactors within the reaction flow of the series of connected reactors of the multistage flow reactor. The change of the definite article used in the original application to the indefinite article in claim 1 does not change subject-matter, but represents only an editorial amendment.

The Appellant further argued that this feature had no support in substance in the original application contrary to Article 123(2) EPC, since Reference Example 1 of the patent in suit clearly distinguished between "reaction solution", which was transferred

between the reactors, and the "starting material" which had a well defined composition. This argument is based merely on an alleged inconsistency between the wording of amended claim 1 and of Reference Example 1 of the patent in suit, but does not amount to a suggestion that there is a lack of support for this amendment in the original application taken as a whole. As there is, however, literal support for this feature on page 7, lines 13 to 15 of the original application, the argumentation of the Applicant cannot succeed.

A further amendment was the addition of a passage at the end of claim 1 (see paragraph III, above), which finds support in original claim 9.

Therefore, the Board considers that the amendments fulfil the requirements of Article 123(2) EPC.

2.2 *Article 123(3) EPC*

The amendments identified above bring about a restriction of the scope of the claims as granted, and therefore of the protection conferred thereby, which is in keeping with the requirements of Article 123(3) EPC.

2.3 *Article 84 EPC*

The terms "upper reactor" and "lower reactor" were objected to by the Appellant as not complying with the requirements of Article 84 EPC, in particular with that of clarity. However, in a claim which addresses the skilled reader, the meaning of these terms is clear. When referring to a multistage reactor system containing a plurality of reactors connected in series

the skilled person, of course, refers to the "upper reactor" as being the reactor placed in an upstream position within the reaction flow and to a "lower reactor" as being a reactor positioned downstream within the reaction flow. The interpretation made by the Appellant, who related the terms "upper" and "lower" with the altitude or the position in space, makes technically no sense in such a process, the Appellant is simply misconstruing the terms. The passage cited by the Appellant in support of his argument relates to the description of a technical drawing (paragraph [0050] of the patent in suit), which specifically refers to "upper parts" or "lower parts" of reactors, thereby merely identifying various positions within the drawing. Since, however, this passage is irrelevant for the question as to whether the wording of claim 1 is clear with regard to the terms "upper reactor" and "lower reactor", the argument of the Appellant is beside the point. Therefore, the Board concludes that the requirement of clarity pursuant to Article 84 EPC is fulfilled.

3. *Novelty*

Novelty was no longer at issue in this appeal. The Board is satisfied that the claimed subject-matter is novel over the cited prior art. Although raised as ground for opposition by the Appellant this issue was no longer in dispute in view of the amendments made to the claims according to the pending main request. Hence no detailed reasoning needs to be given.

4. *Inventive step*

4.1 The patent in suit relates to a process for preparing aldehydes by a multistage hydroformylation reaction of an olefinic unsaturated compound with hydrogen and carbon monoxide; document (1) is also directed to a continuous hydroformulation process.

4.1.1 The process of document (1) operates in two stages of different pressures. In the first reactor the olefin is treated with carbon monoxide and hydrogen in the presence of a catalyst and at a pressure of from 10 to 80 bar (column 2, lines 48 to 49 and claim 2) and in the second reactor the waste gas recovered from the first reactor, which still contains unreacted olefinic starting material, is compressed to a pressure of from 100 to 350 bar and again subjected to a hydroformulation reaction (column 3, lines 3 to 4 and claim 3).

Since document (1) merely discloses values of the overall pressures used in the first and second reactors of the process without giving any details on the partial pressures of the various gaseous components present in the reactors, there is no explicit disclosure of the hydrogen partial pressures used in the first and the second reactor of the process of document (1), nor that the hydrogen partial pressure in the second reactor is higher than in the first reactor. Concerning the composition of the waste gases recovered from the first and second reactors, document (1) indicates that the content of hydrogen is generally from 20 to 40 percent by volume in the waste gas leaving the first reactor and generally from 25 to 40

percent by volume in the waste gas leaving the second reactor (column 2, line 66 to column 3, line 2 and column 3, lines 10 to 14). This information is not related to the composition of the gaseous reactants within the reactors, but to the composition of the gaseous components after completion of the reaction. However, there is no specific disclosure of a particular ratio of the higher hydrogen pressure to the low hydrogen pressure, claimed as ratio of B/A of from 1.2 to 10.

Therefore, both features, the higher hydrogen partial pressure and the B/A ratio, were not explicitly disclosed in document (1).

4.1.2 The Appellant and the Respondent had diverging views on whether document (1) implicitly discloses a hydrogen partial pressure in the second reactor being higher than in the first reactor and whether it discloses the ratio of B/A being within the range of from 1.2 to 10. Calculations as regards the hydrogen partial pressure in both reactors made by the Appellant and by the Respondent were based on the generally disclosed values for the total pressures used in the low pressure and high pressure reactors and on the compositions of the waste gases recovered from each reactor.

However, in executing the above mentioned calculations the Appellant made particular assumptions, e.g. that the composition of the waste gases recovered from the first and the second reactor was identical to the composition of the gaseous reactant mixture present in the respective reactors during the course of the hydroformulation reaction in document (1). Further, the

Applicant in his calculation made the assumption that the second stage of the reaction in reactor 2 necessarily operated at higher hydrogen partial pressures, since the absolute pressure was higher, although the partial pressure depends on the concentration of hydrogen in the gaseous mixture. In the absence of any disclosure concerning hydrogen concentration in combination with absolute pressures, the Appellant speculated with the sole purpose to arrive at higher calculated hydrogen partial pressures in the second reactor and to arrive at calculated B/A ratios within the range as claimed in the patent in suit.

As there is, however, neither any indication nor any evidence in document (1), which could justify these assumptions the Appellant has merely speculated when reading document (1). Therefore, the Board considers the technical features that the second reactor operates at a higher hydrogen partial pressure and that the ratio of B/A within the range of from 1.2 to 10, are not clearly and unambiguously disclosed in document (1).

4.1.3 The Appellant argued that not only document (1), but also document (6) could be regarded as closest state of the art, since this document also related to a continuous hydroformulation process, in which an olefinic compound was reacted in the presence of hydrogen and carbon monoxide to prepare aldehydes. The process was conducted in a primary reactor and a secondary reactor, whereby the secondary reactor was operated at higher pressure (page 3, lines 6 to 10). However, document (6) does not give any information on

the hydrogen partial pressure and indicates only one value for the total pressure of 180 psig in the primary reactor (page 2, line 40 to 41). The Appellant argued that document (6) discloses the transfer of liquid material from the primary reactor to the secondary reactor corresponding to the feature of the reaction starting material of liquid phase being transferred from the upper reactor to the lower reactor. However, the liquid reaction medium, which is exchanged between the primary reactor and the secondary reactor only contains a solution of the catalyst and aldehyde or aldehyde with alcohol product, but no starting material, which is transferred to the secondary reactor in gaseous phase (claims 1 and 7). Since document (6) merely indicates one value for the overall pressure under which the hydroformulation process generally operates, whereas document (1) gives specific pressure ranges for both the low pressure stage and the high pressure stage of the process, document (6) is not closer to the subject-matter of the patent in suit than document (1).

Therefore, the Board, in agreement with the Opposition Division takes document (1) as the closest prior art for the assessment of inventive step.

4.2 Having regard to this prior art the least ambitious technical problem underlying the patent in suit may be formulated as to provide a further hydroformulation process for the preparation of aldehydes.

Only in case the solution to this least ambitious problem were found to be obvious ***vis-à-vis*** the closest prior art, would the issue of whether or not an

improved technical effect was achieved over that prior art, as alleged by the Respondent, arise.

4.3 As a solution to the technical problem defined above the patent in suit proposes the process according to claim 1, which is characterized by the selection of a higher hydrogen partial pressure in the downstream reactor to an extent that it fulfils the ratio of B/A being within 1.2 to 10, and by the feature that reaction starting material of liquid phase is transferred from an upper reactor to a lower reactor.

4.4 The Appellant never disputed that the claimed process produces aldehydes from olefinic compounds and the Board is not aware of any reason for challenging that finding. The patent in suit reveals in Reference Example 1 the preparation of aldehydes according to the hydroformulation process, wherein reaction starting material of liquid phase is transferred from an upper reactor to a lower reactor.

4.5 It remains to be decided whether or not the proposed solution to that objective problem is obvious in view of the state of the art.

4.6 Document (5a) refers to the low pressure hydroformulation process in general and contains schematic drawings of the flow charts of a commercial oxo process for the reaction of propylene with syngas, which operates in one reactor (Fig. 2) and of the product recycle process, which is conducted in reactors A and B (Fig. 3). The schematic drawing of Fig. 3 shows - amongst others - an arrow pointing from the bottom of reactor A towards the bottom of reactor B, thus

indicating an undefined connection between these reactors. However, these drawings merely describe the basic reaction flow within the reactor arrangement without giving any details and in particular without allowing any interpretation as to which specific process steps are operated between these reactors. Thus, the drawings are silent on both the kind of material to be transferred from reactor A to reactor B, and on its state of matter. Further, the arrangement in Fig. 3 is clearly directed to a product recycle process designed for product recovery, but not to the transfer of reaction starting material of liquid phase downstream a multistage flow reactor. Due to the lack of teaching or even a reference to this characterising feature of the proposed solution, document (5a) cannot render the claimed invention obvious.

The same holds true for document (6), which does not disclose or even suggest the transfer of reaction material of liquid phase from an upper to a lower reactor (see paragraph 4.2 above).

4.7 To summarize, in the Board's judgement document (1) taken in combination with either of documents (5a) or(6) does not render the claimed invention obvious.

5. For these reasons, the Board concludes that the subject-matter of claim 1 and by the same token that of dependent claims 2 to 14, which include all the features of claim 1, involves an inventive step within the meaning of Articles 52(1) and 56 EPC.

Auxiliary requests

Since the preceding main request is found to meet the requirements of the EPC for the reasons set out above, there is no need for the Board to decide on the lower ranking auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

D. Magliano R. Freimuth