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Datasheet for the decision of 26 October 2021

Case Number: T 0137/17 - 3.3.10

Application Number: 10795186.5

Publication Number: 2516371

IPC: C07C45/50

Language of the proceedings: EN

Title of invention:
CONTROLLING THE NORMAL:ISO ALDEHYDE RATIO IN A MIXED LIGAND HYDROFORMYLATION PROCESS BY CONTROLLING THE OLEFIN PARTIAL PRESSURE

Patent Proprietor:
Dow Technology Investments LLC

Opponent:
Evonik Operations GmbH

Headword:

Relevant legal provisions:
RPBA Art. 12(4)
EPC Art. 123(2), 100(b), 84, 56, 54(2)

Keyword:

Amendments - allowable (yes)
Claims - clarity - main request (yes)
Insufficiency of disclosure (no)
Inventive step - (yes)
Novelty - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 0137/17 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 26 October 2021

Appellant: (Opponent)	Evonik Operations GmbH Rellinghauserstrasse 1-11 45128 Essen (DE)
Representative:	Eisenführ Speiser Patentanwälte Rechtsanwälte PartGmbB Postfach 10 60 78 28060 Bremen (DE)
Respondent: (Patent Proprietor)	Dow Technology Investments LLC 2020 Dow Center Midland, MI 48674 (US)
Representative:	Boult Wade Tennant LLP Salisbury Square House 8 Salisbury Square London EC4Y 8AP (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 14 November 2016 concerning maintenance of the European Patent No. 2516371 in amended form.**

Composition of the Board:

Chair	P. Gryczka
Members:	R. Pérez Carlón
	W. van der Eijk

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal against the decision of the opposition division on the maintenance of European patent No. 2 516 371 in the form of the main request then pending.

II. This request is also the main request of the respondent (patent proprietor) in these appeal proceedings. Claim 1 reads as follows:

"A method of controlling a multiple-reaction zone, hydroformylation process for producing normal (N) and iso (I) aldehydes at a N:I ratio, the process comprising contacting an olefinically unsaturated compound with carbon monoxide, hydrogen and a catalyst comprising (A) a transition metal, (B) an organopolyphosphite and/or an organopolyphosphoramidite ligand, and (C) an organomonophosphite ligand and/or an organomonophosphoramidite ligand, the contacting conducted in first and subsequent reaction zones and at hydroformylation conditions comprising an olefinically unsaturated compound partial pressure in each zone, the method comprising decreasing the olefinically unsaturated compound partial pressure in the first reaction zone to decrease the N:I ratio or increasing the olefinically unsaturated compound partial pressure in the first reaction zone to increase the N:I ratio."

III. Notice of opposition had been filed on the grounds of added subject-matter (Article 100(c) EPC), insufficiency of disclosure (Article 100(b) EPC), and lack of novelty and inventive step (Article 100(a) EPC).

IV. The documents filed during these proceedings include the following:

D1 WO 2008/115740 A1
D4 Rush *et al.* Kinetics and Catalysis, 2009, vol. 50, No. 4, pages 557-566
D37 US 5,312,996
D38 Project number IS0087. Preparation of polyphosphite ligand A according to US Patent 5312996

V. The opposition division concluded that claim 1 of the main request found the required basis in the application as originally filed and was clear. The claimed invention was sufficiently disclosed for it to be carried out by a person skilled in the art, and the claimed method was novel over that of D4. Document D1 was the closest prior art, and the problem underlying the claimed invention was to provide an alternative method for controlling N:I ratio in an hydroformylation process. The claimed solution, characterised by increasing or decreasing the partial pressure of the olefinically unsaturated compound, would not have been obvious to the skilled person. The conclusion would have been the same if document D4 were considered to come closest to the claimed invention.

VI. The arguments of the appellant were as follows.

Documents D37 and D38 were filed as evidence of an argument raised before the opposition division. They should thus be admitted into the proceedings.

Claim 1 encompassed a number of combinations arising from the feature "(B) an organopolyphosphite and/or an organopolyphosphoramidite ligand, and (C) an organomonophosphite ligand and/or an organomono-

phosphoramidite ligand". Each combination required a basis in the application as originally filed. Since such basis could not be found, claim 1 contained added subject-matter.

The feature "(B) an organopolyphosphite and/or an organopolyphosphoramidite ligand, and (C) an organomonophosphite ligand and/or an organomonophosphoramidite ligand" contained the term "ligand" only once for component (B). It was thus not clear whether claim 1 required organopolyphosphite ligands or organopolyphosphites in general.

The data in the patent did not show that the process' selectivity could be controlled by means of the partial pressure of the olefinically unsaturated compound. Document D4 also provided evidence in this respect. The claimed invention was thus not sufficiently disclosed for it to be carried out by a person skilled in the art.

Document D4 disclosed a process in the presence of a organopolyphosphite ligand which inevitably also contained monophosphite. D4 carried out multiple experiments which amounted to "multiple reaction zones", as required by claim 1. For these reasons D4 disclosed all the features of claim 1, which was thus not novel.

Either document D1 or D4 could be a suitable starting point for examining inventive step. If document D1 were to be seen as closest, the problem underlying the claimed invention was to provide an alternative method of controlling N:I ratio in a hydroformylation reaction. The claimed solution, characterised by increasing or decreasing the partial pressure of

olefinically unsaturated compound, would have been obvious to the skilled person having regard to page 560 of D4. The claimed method was thus not inventive.

VII. The arguments of the respondent (patent proprietor) relevant to the present decision were as follows.

D37 and D38 were not relevant and could have been filed earlier. They should not be admitted into the proceedings.

The amendments of claim 1 found a basis in paragraph [0029] of the application as originally filed. Claim 1 thus did not go beyond that disclosure. It was furthermore clear to the skilled reader that features (B) and (C) necessarily related to ligands. Document D4 neither disclosed a ligand of type (C) required by claim 1 nor multiple reaction zones. The claimed method was thus novel.

Document D1 was the closest prior art and the problem underlying the claimed invention that of providing an alternative method of controlling N:I ratio in a hydroformylation process. The solution was characterised by modifying the partial pressure of olefinically unsaturated compound. D4 would not have taught the skilled person the claimed solution, which was thus inventive.

VIII. The board informed the parties in the annex to the summons for oral proceedings, dated 3 July 2019, that it was inclined to consider that claim 1 found the required basis in the application as originally filed and was clear. It was also inclined to conclude that the claimed method was novel. D1 came closest to the claimed invention. It was neither disputed that the

problem underlying the claimed invention was that of providing an alternative, nor that it was credibly solved by the claimed method. It lastly indicated that it would need to be discussed at the oral proceedings whether the claimed solution would have been obvious having regard to the prior art.

IX. The appellant withdrew its request for oral proceedings with a letter dated 25 February 2020. It also informed the board with a letter dated 23 September 2020 that it would not be attending the oral proceedings.

X. With a letter dated 9 March 2020, the respondent requested oral proceedings only if the board would not dismiss the appeal.

XI. The board informed the parties in a communication dated 24 November 2020 that it was not in a position to cancel the scheduled oral proceedings. The issue of inventive step needed to be discussed. The claimed solution appeared to have been obvious to the skilled person having regard to D4.

XII. The respondent filed arguments in favour of inventive step with a letter dated 13 August 2021. It argued that the skilled person would not have considered the results of D4 to apply to a catalyst system as that of D1, which also required a monophosphite ligand. Even if D1 and D4 were to be combined, the latter did not teach the claimed solution.

XIII. With a communication dated 5 October 2021 the board cancelled the already summoned oral proceedings.

XIV. The requests of the parties were as follows:

- The appellant requested that the decision under appeal be set aside and the patent revoked.

- The respondent requested that the appeal be dismissed or, subsidiarily, that the patent be maintained on the basis of the first or second auxiliary request, filed with the response to the grounds of appeal.

Reasons for the Decision

1. The appeal is admissible.

2. Documents D37 and D38

D37 and D38 were filed with the statement of grounds of appeal. They are part of these appeal proceedings unless the board considers them inadmissible under the conditions set by Article 12(4) RPBA 2007. The respondent requested that D37 and D38 not be admitted into the proceedings, as they were not relevant.

D37 and D38 seek to provide evidence on an argument already put forward during opposition proceedings in the context of novelty, namely that monophosphites were inevitably present in the process disclosed in D4.

The question of their admittance can be left open, as the board has come to the conclusion (see paragraph 6 Novelty) that D4, even with the additional evidence in D37 and D38, does not take away novelty of the main request.

3. Amendments

3.1 Claim 1 as originally filed required a catalyst comprising

(A) a transition metal
(B) an organopolyphosphite, and
(C) an organomonophosphite ligand

Claim 1 of the main request requires

(A) a transition metal
(B) an organopolyphosphite and/or an organopolyphosphoramidite ligand, and
(C) an organomonophosphite ligand and/or an organomonophosphoramidite ligand.

3.2 Paragraph [0029] of the application as originally filed provides the required basis for this amendment. It discloses that "any organomonophosphoramidite ligand can be used as, or in combination with, the organomonophosphite ligand used in the practise of this invention". This passage thus discloses feature (C) of claim 1. It continues by disclosing that "any organopolyphosphoramidite ligand can be used as, or in combination with, the organopolyphosphite ligand used in the practise of this invention". This second passage provides thus a basis for feature (B) of claim 1 (Article 123(2) EPC).

3.3 Designating the members of each class by (B1) organo-polyphosphite ligand, (B2) organopolyphosphoramidite ligand, (C1) organomonophosphite ligand and (C2) organomono-phosphoramidite ligand, claim 1 requires

B1 and/or B2, and C1 and/or C2.

The appellant argued that claim 1 required an explicit

basis in the application as originally filed for each of the combinations arising from that feature, namely B1+C1, B1+C2, B1+C1+C2, B2+C1, B2+C2, B2+C1+C2, B1+B2+C1, B1+B2+C2 and B1+B2+C1+C2, and not every combination found the required basis.

3.4 However, claim 1 does not individualise any of these combinations. This argument is thus not convincing.

4. Clarity

4.1 Features (B) and (C), defining the catalyst's ligands required by claim 1, are worded as follows:

> (B) an organopolyphosphite and/or an organopolyphosphoramidite ligand, and
> (C) an organomonophosphite ligand and/or an organomonophosphoramidite ligand

4.2 The appellant argued that this wording was not clear, as feature (B) included the term "ligand" only once, whereas feature (C) restricted both the required monophosphite and monophosphoramidite to those being a "ligand". It was not clear whether feature (B) restricted polyphosphites only to those being ligands or merely required any polyphosphite.

Polyphosphites are known transition metal ligands, and are frequently used in hydroformylation processes. There is overwhelming evidence in this respect on file, for example D1 and D4, and this is not disputed. The skilled reader, in the context of catalytic hydroformylation with transition metals, would have considered the polyphosphites required by claim 1 to be ligands of the metal. For this reason alone, the

appellant's argument is not convincing.

5. Sufficiency of disclosure

5.1 Claim 1 is directed to a method of controlling a multiple-reaction zone by decreasing or increasing the olefinically unsaturated compound partial pressure. An increase in the partial pressure increases N:I ratio. N:I ratio can be decreased by decreasing the olefin's partial pressure.

5.2 The appellant argued that the data in the patent in suit did not show that the process regioselectivity could be effectively controlled by changing the partial pressure of olefin.

However, the table on paragraph [0050] of the patent in suit shows that an increase of the partial pressure of the order of magnitude of a tenfold (from ca. 2 psi to ca. 20 psi) enhances the relative amount of linear aldehyde (compare second and third blocks, or fourth and fifth blocks, of the table).

This table also shows that decreasing the olefin's partial pressure enhances the relative amount of branched aldehyde produced (compare blocks three and four, or blocks five and six). The claimed invention can be thus carried out by the person skilled in the art.

5.3 The appellant also argued that, according to the data in the patent in suit, a decrease of 39% in partial pressure did not induce a decrease of N:I ratio.

However, this speaks in favour of the sufficiency of the patent disclosure and not against it. It discloses

the order of magnitude of the variation of olefin's pressure required for changing the N:I ratio.

5.4 In a different line of argument, the appellant considered that document D4 proved that a change in olefin partial pressure could not affect the regioselectivity of the reaction, and relied in this respect on experiments 14, 5, 15 and 10 thereof.

However, the partial pressure of syngas, which also affects the N:I ratio of the process, is not maintained constant in any of these experiments. For this reason alone, this argument is not convincing.

6. Novelty

6.1 The opposition division concluded that document D4 did not disclose a hydroformylation process in the presence of a monophosphite ligand (C). It also concluded that the process of D4 was not carried out in a multiple-reaction zone. For these reasons, the claimed method was novel.

6.2 Document D4 is a kinetic study carried out using a diphosphite ligand (L) which is a component (B) according to claim 1. It was undisputed that D4 does not explicitly disclose a monophosphite ligand (C).

6.3 The appellant argued that the presence of a ligand (C) in the method of D4 was inevitable. The ligand of D4 was obtained according to the process of D37. Experimental evidence D38 proved that the method of D37 leads to the concomitant production of monophosphite.

6.4 Document D4 neither provides details on the ligand's synthesis, nor on its purification. However, D4

discloses the ^{1}H NMR data of the ligand used (first paragraph in the experimental section, page 558). The presence of monophosphite, which would not be unexpected as the process of D37 requires only 2 equivalents of biphenol chloridite, would have been easily detected in a ^{1}H NMR spectrum, as shown by Figure 8 of document D38.

Be it as it may, the evidence on file shows that monophosphite could have been present, but fails to show that it must inevitably have been the case.

6.5 For this reason alone, the claimed subject-matter is novel over D4.

7. Inventive step

7.1 Closest prior art

The appellant argued that both D1 or D4 could be the closest prior art.

Document D1 relates, as the claimed invention, to the control of N:I isomers ratio in a hydroformylation process by varying its reaction parameters, in particular the relative amount of ligand to transition metal. In contrast, document D4 relates to a kinetic study which aims at elucidating the hydroformylation's reaction mechanism. For this reason alone, document D1 comes closer to the claimed invention.

Document D1 does not disclose changing the olefin partial pressure in order to modify the reaction regioselectivity. This is undisputed.

7.2 Problem underlying the claimed invention

It was common ground that the problem underlying the claimed invention was to provide an alternative method for controlling N:I ratio in a hydroformylation process catalysed by transition metals in combination with ligands of the structure (B) and (C).

7.3 Solution

The claimed solution is the method of controlling of claim 1, characterised by either

- decreasing the olefinically unsaturated compound partial pressure in the first reaction zone to decrease the N:I ratio, or
- increasing the olefinically unsaturated compound partial pressure in the first reactor zone to increase the N:I ratio.

7.4 Having regard to the data in the patent in suit, the problem as formulated above can be considered as solved (see points 5.2. and 5.3 above).

7.5 It remains to be examined whether the skilled person would have considered modifying the partial pressure of unsaturated reagent in order to modify the reaction's regioselectivity.

7.6 The appellant argued that, seeking an alternative, the skilled person would have consulted a document such as D4. D4 relates to a mechanistic study of a Rh-catalysed hydroformylation in the presence of a bidentate ligand of the type (B) according to claim 1. Page 560, left column, third full paragraph of D4 would have taught the skilled person the claimed solution.

7.7 Document D4 relates, however, to a catalyst system different from that of D1. It contains indeed, as the catalyst of D1, Rhodium and a bidentate phosphite ligand. It differs, however, in various respects.

The relative amount of ligand and metal is different. D4 teaches a 2:1 ligand:Rh ratio as most preferred (see section "Effects of the Rhodium and ligand concentrations" on page 559) and discloses a sharp regioselectivity decrease by reducing the relative amount ligand:Rh from 2 to 1. In contrast, the process of D1 requires a sub-stoichiometric amount of ligand with respect to metal (claim 1, lines 13-14).

The catalyst of D1 further requires the presence of monodentate ligands (C), which are not part of the catalyst of D4. D4 discloses that the relationship between reaction rates or regioselectivity on the one hand, and ligand:Rh ratio on the other, was not consistent with previously published results for other diphosphites and monophosphites (page 559, right column, first paragraph). This would have taught the skilled reader that the results of D4 applied only to the specific system studied, or at least that they should be taken with care.

The skilled reader would thus not have combined the teaching of D4 with that of D1 as they relate to different catalyst systems, and D4 recognised that its results were at variance with previously known data.

The skilled person would thus not have been prompted to modify the partial pressure of the olefinically unsaturated compound in the expectation of controlling the N:I ratio of a hydroformylation process. The claimed solution is thus inventive (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

C. Rodríguez Rodríguez P. Gryczka

Decision electronically authenticated