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**Datasheet for the decision
of 11 April 2022**

Case Number: T 1886/18 - 3.3.02

Application Number: 10765548.2

Publication Number: 2488539

IPC: C07F9/145, C07F9/6574,
C07B41/06, C07C45/50

Language of the proceedings: EN

Title of invention:

GAS PHASE HYDROFORMYLATION PROCESS

Patent Proprietor:

Dow Technology Investments LLC

Opponent:

Evonik Operations GmbH

Headword:

Relevant legal provisions:

RPBA Art. 12(4)
EPC Art. 56, 83

Keyword:

Late-filed facts
Inventive step
Sufficiency of disclosure

Decisions cited:

T 1961/17

Catchword:



Beschwerdekammern

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Case Number: T 1886/18 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 11 April 2022

Appellant: Evonik Operations GmbH
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Respondent: Dow Technology Investments LLC
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 15 June 2018
rejecting the opposition filed against European
patent No. 2488539 pursuant to
Article 101(2) EPC**

Composition of the Board:

Chairman M. O. Müller
Members: P. O'Sullivan
M. Blasi

Summary of Facts and Submissions

I. The appeal of the opponent (hereinafter appellant) lies from the decision of the opposition division according to which the opposition against European patent 2 488 539 was rejected.

According to the contested decision:

- the invention defined in the claims as granted was disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, and
- the subject-matter of the granted claims involved an inventive step over *inter alia* D1 as closest prior art.

II. The following documents *inter alia* were cited during opposition proceedings:

- D1: A Riisager *et al.*, Journal of Molecular Catalysis A: Chemical 193 (2003) 259-272
- D2: WO 97/20794
- D3: US 4,768,498
- D4: US 5,767,321
- D5: US 5,288,918

III. The following further documents were cited in the appeal proceedings:

- A009: D6, pages 55-57,73
- A010: US 3,527,809
- A011: Wikipedia: "Triethylphosphit"

Further documents were submitted in appeal proceedings, specifically A007, A008, A012 and A013. None of these documents needed to be addressed in the present decision as they were filed in relation to aspects which were not relevant for reaching this decision.

IV. Requests relevant to the present decision

- The appellant requested that the contested decision be set aside, and that the patent be revoked in its entirety.
- The respondent requested maintenance of the patent as granted i.e. rejection of the opposition, implying dismissal of the appeal, or alternatively, maintenance of the patent in amended form on the basis of one of the sets of claims of auxiliary requests 1 to 3 submitted with the reply to the statement of grounds of appeal.

V. Independent claim 1 of the main request (patent as granted) reads as follows:

"A hydroformylation process for production of at least one aldehyde product, the process comprising: contacting under gas phase reaction conditions carbon monoxide, hydrogen and one or more olefinically-unsaturated compounds in the presence of a hydroformylation catalyst, wherein the catalyst comprises a catalytic metal and a ligand comprising at least one organophosphite ligand, wherein the catalyst is physisorbed on a support, and wherein water vapor is present at least part of the time"

VI. With a communication pursuant to Article 15(1) RPBA 2020, the board set out its

preliminary opinion. Therein, the board *inter alia* expressed the view that the assessment of inventive step could start from either of documents D1 and D3. Furthermore, the appellant's objections with regard to sufficiency of disclosure for claim 1 of the main request were found not to be convincing.

VII. As requested, oral proceedings were scheduled, and were held on 11 April 2022 by videoconference in the presence of both parties.

VIII. The appellant's case, insofar as relevant to the present decision, may be summarised as follows:

Main request

- The objections of lack of inventive step starting from D2 or D4 as closest prior art should be admitted into the appeal proceedings.
- The subject-matter of claim 1 lacked inventive step starting from D1 as closest prior art in combination with *inter alia* D4.

Auxiliary request 2

- The subject-matter of claims 1 and 10 lacked inventive step starting from D1 as closest prior art in combination with D2 or D4.

IX. The respondent's case, insofar as relevant to the present decision, may be summarised as follows:

Main request

- The objections of lack of inventive step starting from D2 or D4 as closest prior art should not be admitted into the proceedings pursuant to Article 12(4) RPBA 2007.
- The subject-matter of claim 1 involved an inventive step starting from D1 as closest prior art in combination with *inter alia* D4.

Auxiliary request 2

- The subject-matter of claim 1 involved an inventive step starting from D1 as closest prior art in combination with D2 or D4.

Reasons for the Decision

1. Admittance - new inventive step objections

With the statement of grounds of appeal, the appellant submitted inventive step objections starting from any of D1, D2, D3 or D4 as closest prior art.

It was undisputed that the objections starting from D2 or D4 had not been raised by the appellant during proceedings before the opposition division.

The respondent requested that said objections not be admitted into the proceedings pursuant to Article 12(4) RPBA 2007.

The appellant justified admittance on the basis that said objections merely represented new arguments, which could always be raised in appeal proceedings, and therefore were not to be considered as late.

The board disagrees. The new objections based on D2 and D4 represent new alleged facts (based on evidence already on file), and not merely new arguments. This is in line with the distinction drawn for example in decision T 1691/17 (reasons 2.4 - 2.6).

Accordingly, the admittance of these objections is subject to the discretion of the board in accordance with Article 12(4) RPBA 2007 (which applies to the present case according to Article 24 and Article 25(2) RPBA 2020). Under this provision, the board has the power not to admit into the proceedings, *inter alia* facts which could have been presented before the opposition division, even though they were presented with the statement of grounds of appeal, relate to the case under appeal and meet the requirements under Article 12(2) RPBA 2007.

The appellant did not provide any reasons why the objections starting from D2 or D4 could not have been presented before the opposition division, and none were apparent to the board. The opposition proceedings ended with a rejection of the opposition and, hence, invoking new objections of lack of inventive step amounts to initiating a fresh case, contrary to the primary object of the appeal proceedings, which is to review the decision under appeal in a judicial manner.

Consequently, the board decided not to admit the new inventive step objections based on D2 or D4 as closest prior art into the appeal proceedings pursuant to Article 12(4) RPBA 2007.

2. Inventive step - Article 100(a) and Article 56 EPC

The contested patent sets out to provide a gas phase hydroformylation process which can maintain substantially stable activity over time (patent, paragraph [0008]).

Granted claim 1 (supra), in summary, is directed to a hydroformylation process for production of at least one aldehyde product, comprising:

- reacting carbon monoxide, hydrogen, and an olefinically unsaturated compound
- under gas phase reaction conditions
- in the presence of a catalyst comprising a metal and at least an organophosphite ligand;
- wherein the catalyst is physisorbed on a support; and
- wherein water vapour is present at least part of the time.

2.1 Closest prior art

In addition to the objections of lack of inventive step based on D2 and D4 which as set out above, were not admitted into the proceedings, the appellant argued that the subject-matter of contested claim 1 lacked inventive step starting from D1 or D3 as closest prior art.

The respondent argued that D1 was not a "suitable starting point for the skilled person", and therefore did not represent the closest prior art, which was represented by D3, with the consequence that D1 could not be taken into account for inventive step.

D1 (page 262, right hand column, point 2.4 entitled "Continuous propene hydroformylation using SAP catalysts") discloses a gas phase hydroformylation process. The SAP catalyst used in this process comprises NORBOS (an organophosphine ligand; scheme 1, structures 5 and 6), and rhodium as the catalytic metal (D1, point 2.3 "Preparation and characterization of SAP catalysts").

D1 therefore discloses a catalyst similar to that of the contested patent, for the same purpose, namely a gas phase hydroformylation process and is thus located in the same technical field as the contested patent.

The respondent argued that since the patent concerned the objective technical problem of improving the activity of known organophosphite ligands, one skilled in the art of hydroformylation processes would not look to D1. Specifically, D1 disclosed fundamentally different catalysts in which the ligand was not only an organophosphine (in contrast to the claimed phosphite ligands), but also comprised ionic SO_3M groups.

The board did not find the respondent's arguments convincing. The patent itself sets out that heterogeneous versions of homogeneous catalyst systems are very common, and refers to prior art processes using fixed bed vapour phase catalysts for hydroformylating propylene ([paragraph 0004]). According to paragraph [0005], significant activity

decline was observed with the vapour phase catalyst. In paragraph [0008] it is stated "*it would be desirable to have a gas phase hydroformylation process that would be able to maintain substantially stable activity over time compared to the processes of the prior art*". Therefore, the patent itself aims to improve prior art vapour phase hydroformylation processes, and is not concerned with "*the objective technical problem of improving the activity over time of the known catalysts containing organophosphite ligands...*", as set by the respondent (e.g. reply to the statement of grounds of appeal, page 15, final paragraph). Since D1 discloses such a vapour phase hydroformylation process, there is no reason not to consider it as the starting point in the assessment of inventive step of the claimed subject-matter.

The question of whether, with regard to the claimed subject-matter, document D3 is indeed a "closer" prior art disclosure than D1 does not have to be addressed, since even if accepted, the claimed subject-matter must involve an inventive step over D1, in accordance with Article 56 EPC.

2.2 Distinguishing features

The respondent argued that the subject-matter of contested claim 1 differed from D1 in that

- the catalyst comprised a ligand comprising at least one organophosphite, while the ligand of D1 was (1) ionic, and (2) a bisphosphine (an organophosphine ligand), and
- the catalyst was physisorbed on a support.

With regard to the first feature however, the board notes that contested claim 1 does not specify whether the ligand thereof is ionic or not. Therefore, the distinguishing feature is to be regarded merely as the use in contested claim 1 of an organophosphite ligand, instead of the organophosphine ligand employed in D1.

With regard to physisorption, the following applies. Paragraph [0014] of the patent defines the expression "physisorbed on the support" in the context of the metal-ligand complex as meaning that there is *"substantially no sigma bonding between any atom of the complex and any atom of the support"*. The respondent argued, referring to D1 (page 268, paragraph bridging left and right hand columns) that during the hydroformylation reaction, in the active catalytic species, there was an ionic interaction between alkali-metal-sulfonate groups of the catalyst and the surface of the support, such that the catalyst was not physisorbed onto the support.

This argument failed to convince the board. Even if it were to be accepted that an ionic interaction takes place between the catalyst of D1 and the support as argued by the respondent, there is no reason to believe that such interaction would imply the presence of sigma bonds precluding defining the catalyst as physisorbed. In fact, the respondent did not even argue that such sigma bonds were present. Furthermore, as noted by the appellant, contested claim 1 does not exclude ionic ligands, and even though paragraph [0038] of the patent states that ionic ligand are not preferred, it also does not exclude them. Therefore, there is no reason not to consider the catalyst of D1 as being physisorbed on a support.

The claimed subject-matter thus differs from D1 solely in that the catalyst comprises an organophosphite ligand, while the ligand of D1 is an organophosphine ligand.

3. Problem solved

In example 3 of the patent a catalyst according to claim 1 was tested. The results are depicted in figure 1, which shows that after an initial catalyst break-in period, catalyst activity is maintained at least up to about 19 days.

It was conceded by the respondent during oral proceedings that there was no data on file comparing the results of the claimed process with the process disclosed in D1 comprising an organophosphine catalyst.

Therefore, as noted by the board during oral proceedings, there is no evidence that the claimed process is superior to the process of D1, and thus no improvement in the maintenance of catalyst activity vis à vis the process of D1 can be acknowledged.

In view of this, the respondent submitted that the objective technical problem underlying the subject-matter of claim 1 was "*the provision of a hydroformylation reaction in which [catalyst] activity was maintained over time*".

The board accepts the respondent's formulation of the objective technical problem.

3.1 Obviousness

The appellant argued that the skilled person starting from D1 and faced with the objective technical problem formulated above, would have arrived at the claimed solution in view of the teachings of *inter alia* document D4.

It was undisputed that hydroformylation reactions employing as catalysts metal complexes comprising organophosphite ligands were known from *inter alia* document D4. The respondent however argued that D4 was exclusively directed to liquid phase hydroformylation processes, and there thus would have been no incentive for the skilled person to employ the organophosphite ligands disclosed therein in the gas phase process of D1.

The board disagrees. D4 discloses a hydroformylation process in which a catalyst comprising organophosphite ligands is employed (column 4, lines 52-57; column 6, lines 40-60). Specific examples of organophosphite ligands are also provided in D4, and include ligands preferred according to the contested patent (e.g. D4, ligand A, column 11; patent, ligand A on page 8). While D4 focuses on a liquid phase hydroformylation reaction (all examples are carried out in the liquid phase), the teaching of D4 is not limited to the liquid phase. As indicated by the appellant, D4 also discloses that the process may be conducted in either liquid or the gaseous state (column 4, lines 9-14).

The skilled person, seeking to solve the objective technical problem set out above would therefore, with reasonable expectation of success, have replaced the organophosphine ligands of D1 with the organophosphite

ligands of D4, and thereby would have arrived at the claimed subject-matter.

The respondent's arguments to the contrary failed to convince the board.

It was argued that D1 concerned a fundamentally different type of catalyst to the metal-organophosphite catalysts of D4 such that the skilled person would not have considered replacing the former with the latter. Specifically, as set out in paragraph [0068] of the patent, the catalyst of D4 (which is as defined in the patent) is not directly affected by water (the catalyst is not water-soluble), and the water is required only to remove decomposed ligand fragments. In contrast, in D1, water was required to maintain a water layer at the aqueous-organic interface on the support, the latter being necessary for the functioning of the catalyst itself (D1, page 259, right hand column; pages 267-268, section 3.3.2). The board notes however that while D1 indeed postulates that water affects the catalyst in this way, it appears not to be the only explanation of the mechanism of action of the catalyst. As noted by the board during oral proceedings, and as demonstrated in figure 4 of D1, the catalyst of D1 also functions only marginally less well when water is not present (D1, figure 4, compare the reaction rate of 0.3 mmol/(sgRh) at $y(\text{H}_2\text{O}) = 0$ versus the optimal rate of approximately 0.38 mmol/(sgRh) at $y(\text{H}_2\text{O}) = 0.1$). There is therefore no reason to consider the catalysts of D4 to be fundamentally different from those of D1 to the extent that the skilled person would have excluded their replacement with the organophosphite ligands disclosed in D4.

The respondent also argued that even if the skilled person would have replaced the organophosphine ligands of D1 with organophosphites of D4, the skilled person would not have done so without also removing the water employed in the process of D1. Therefore, the skilled person would not have arrived at the subject-matter of contested claim 1, which requires water vapour to be present at least some of the time.

The board disagrees. Having chosen to replace the organophosphine ligand of D1 with the organophosphite ligands of D4 as set out above, there would have been no reason for the skilled person to remove the water from the hydroformylation process of D1. Specifically, there is no incentive nor teaching in the prior art that the process of D1 would not function in the presence of water after the introduction of an organophosphite ligand. More importantly, D4 indicates that the hydroformylation reaction in the presence of an organophosphite ligand preferably takes place in the presence of a minor amount of water (column 27, lines 12-25), specifically from about 0.05 to about 10 weight percent. The purpose of the water is to maintain the concentrations of phosphorous acidic compounds (which cause catalyst poisoning; D4, column 1, lines 30-33) below the threshold level that causes rapid degradation of the organopolyphosphite ligand. Therefore, D4 provided the skilled person with every reason to maintain, and therefore not remove, the water taught in D1.

It follows from the foregoing that the ground for opposition under Article 100(a) in combination with Article 56 EPC prejudices the maintenance of the patent as granted.

Auxiliary request 1

The set of claims of auxiliary request 1 essentially differs from that of the main request by the addition of the following text in claim 1: "*the amount of water in moles is at least 0.001 time the amount of Rh in moles*".

4. Inventive step - Article 56 EPC

As set out above with regard to claim 1 of the main request, the skilled person starting from the disclosure of D1 and having chosen to replace the organophosphine ligands disclosed therein with the organophosphite ligands of D4 would not have removed the water present during the hydroformylation process of D1.

Consequently, the subject-matter of claim 1 of the first auxiliary request lacks inventive step pursuant to Article 56 EPC.

Auxiliary request 2

The set of claims of auxiliary request 2 essentially differs from that of the main request by the addition of the following text in claim 1: "*the catalyst is contacted with a buffer solution after some aldehyde is produced*".

5. Inventive step - Article 56 EPC

5.1 According to the appellant, the subject-matter of claims 1 and 10 lacked inventive step starting from D1 as closest prior art in combination with *inter alia* D4.

5.2 Distinguishing features and problem solved

It was not disputed that D1 does not disclose the above feature added to claim 1, and therefore that this feature represents a further distinguishing feature compared to claim 1 of the main request.

According to the respondent, the objective technical problem remained the same as for the main request, namely the provision of a hydroformylation reaction in which catalyst activity was maintained over time.

As set out above for claim 1 of the main request, the respondent's formulation of the objective technical problem can be accepted on the basis of the distinguishing feature for that claim.

Furthermore, the additional distinguishing feature present in claim 1 of auxiliary request 2 contributes to the solution of this problem: example 8 of the patent, or the application, respectively, demonstrates that contacting the catalyst with a buffer solution leads to a maintenance of catalytic activity. Specifically, after operating the hydroformylation process for 24 hours, the pressure is dropped and the feed gases are shut off. The catalyst bed is then covered with the buffer solution for 15 minutes, which is then syringed off. After reactivation of the catalyst, the original feed flows are continued. The results are depicted in figure 5, and show how the rate of aldehyde production increases after buffer treatment of the catalyst on day 2.

It is also noted in this regard that the objective technical problem according to the appellant, although worded differently from the above problem, namely as

the provision of an alternative hydroformylation process, is not different to the problem formulated by the respondent, in terms of meaning. Specifically, both formulations indicate that the claimed process does not represent an improvement over the process disclosed in D1.

6. Obviousness

The appellant argued that the subject-matter of claim 1 was rendered obvious by D2 or D4.

The disclosures of D2 and D4 were used interchangeably by both the appellant and the respondent in arguments concerning the buffer solution, and no distinction was made between the two documents. Although the board focuses on D4, the same considerations apply equally to D2.

D4 discloses treating at least a portion of a metal-organopolyphosphite ligand complex catalyst containing reaction product fluid derived from the hydroformylation process, which also contains phosphorus acidic compounds formed during said hydroformylation process, with an aqueous buffer solution in order to neutralise and remove at least some amount of the phosphorus acidic compounds from said reaction product fluid. The treated reaction product fluid is then returned to the hydroformylation reaction zone or separation zone (column 37, lines 32-42). Although as set out above, the general teaching of D4 is not limited to liquid phase hydroformylation processes, this specific disclosure in relation to the addition of an aqueous buffer concerns a homogeneous liquid phase process. As noted by the respondent, the way in which the aqueous wash is carried out in D4

differs from that of the gas phase process exemplified in the patent (example 8). Specifically, according to D4, the aqueous buffer solution is used to treat a reaction medium of a continuous liquid catalyst recycle hydroformylation process that has been removed from the reaction zone, and preferably involves treating all of the reaction product fluid after distillation of the aldehyde product, preferably through a liquid extractor (D4, column 37, lines 50-65). Therefore, a complex work-up procedure was required. In contrast, as set out above, the treatment of the heterogeneous gas phase catalyst of the patent with aqueous buffer proceeds entirely differently in that the gas phase hydroformylation reaction is first stopped, and the catalyst bed is treated with the buffer solution in situ in the reactor. Therefore, although an aqueous buffer is taught in D4 for the same intended purpose as the buffer solution of contested claim 1, it would not have been a trivial matter for the skilled person to adapt the treatment with aqueous buffer in the hydroformylation process of D4, which is taught exclusively in the context of a homogenous liquid phase catalyst, to the process of D1 carried out with a heterogeneous catalyst in the gas phase.

It follows that the subject-matter of claim 1 of auxiliary request 2 involves an inventive step pursuant to Article 56 EPC.

The appellant furthermore submitted at oral proceedings that the same arguments in respect of claim 1 of auxiliary request 2 applied equally to the subject-matter of claim 10, and nothing was to be added over what had been stated for claim 1.

As set out above with regard to claim 1 of auxiliary request 2, the board found the appellant's arguments to be unconvincing. Therefore, in the absence of any convincing arguments as to why the conclusion for claim 1 would not apply to claim 10 of auxiliary request 2, the subject-matter of the latter involves an inventive step pursuant to Article 56 EPC.

7. Sufficiency of disclosure

During the discussion in oral proceedings concerning the set of claims of auxiliary request 2, after addressing inventive step, the appellant stated that the only remaining objection was one of lack of sufficiency of disclosure directed to the subject-matter of claims 1 and 10. The appellant however relied on its written submissions and confirmed that nothing was to be added orally (minutes, page 5, fourth paragraph).

The written submissions were absent any specific argumentation in relation to sufficiency of disclosure for the set of claims of auxiliary request 2 (letter of 7 April 2019, point 6; letter of 10 February 2022, point 4). In the communication pursuant to Article 15(1) RPBA 2020, the appellant's objections in relation to sufficiency of disclosure for the main request were rejected: the board found the invention defined in claim 1 of the main request to be sufficiently disclosed. Since those objections failed to convince the board, in the absence of further arguments, the same must apply in relation to claim 1 of auxiliary request 2.

- 7.1 Claim 11 of the main request is identical to claim 10 of auxiliary request 2. In relation to the former, no specific arguments were submitted by the respondent. Similarly therefore, there are no specific arguments on file in relation to claim 10 of auxiliary request 2 over and above those submitted for claim 1 thereof. In the absence of any further arguments therefore, the above conclusion for claim 1 of auxiliary request 2 applies equally to claim 10 thereof.
- 7.2 It follows that the invention defined in claims 1 and 10 of auxiliary request 2 is disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.
8. In the absence of any further objections, the set of claims of auxiliary request 2 can be allowed.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the opposition division with the order to maintain the patent in amended form with the following claims and a description and drawings to be adapted thereto:

claims 1 to 11 of auxiliary request 2 filed with the statement of grounds of appeal.

The Registrar:

The Chairman:



M. Schalow

M. O. Müller

Decision electronically authenticated