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**Datasheet for the decision
of 10 March 2022**

Case Number: T 1368/18 - 3.3.10

Application Number: 10709097.9

Publication Number: 2411350

IPC: C07C1/24, C07C15/46

Language of the proceedings: EN

Title of invention:
DEHYDRATION OF 1-PHENYL ETHANOL

Patent Proprietor:
Lyondell Chemical Technology, L.P.

Opponent:
Repsol, S.A.

Headword:

Relevant legal provisions:
EPC Art. 100(a), 56

Keyword:
Inventive step - (no)

Decisions cited:

T 0547/88, T 0197/86, T 0020/81

Catchword:



Beschwerdekammern

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Case Number: T 1368/18 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 10 March 2022

Appellant: Lyondell Chemical Technology, L.P.
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 3 April 2018
revoking European patent No. 2411350 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chair P. Gryczka
Members: R. Pérez Carlón
L. Basterreix

Summary of Facts and Submissions

- I. The appellant (patent proprietor) lodged an appeal against the decision of the opposition division revoking European patent No. 2 411 350.
- II. Notice of opposition had been filed on grounds that included lack of inventive step (Article 100(a) EPC).
- III. The documents filed include the following:
- D1 The Merck Index, eleventh edition 1989, pp. 1501-1502
 - D3 US 5,639,928
 - D5 US 3,526,674
 - D9 Declaration of J.L. Esteban from Cromogenia Units S.A. on the product CELESAL PTS.
 - D16 US 4,155,945
 - D17 Declaration of Kevin Fogarty dated 19 May 2016
 - D18 Experimental evidence filed as a declaration of Kevin Fogarty dated 28 November 2016
 - D22 Technical report by Marcil Cordeiro Alves and Jordi Pedrola Vidal dated 20 November 2017
- IV. Claim 1 of the patent as granted, which is the appellant's main request, reads as follows:
- "A process to produce styrene, which comprises dehydrating 1-phenyl ethanol in the liquid phase in the presence of a para- and ortho-toluenesulfonic acid mixture, having a para-toluenesulfonic acid:ortho-toluenesulfonic acid ratio in the range of from 1:9 to 20:1."*

Claim 1 of auxiliary request I requires the ratio of

para- to ortho-isomer to be in the range of 1:1 to 8:1.

Claim 1 of auxiliary request II has the features of claim 1 of the main request and further requires:

"wherein the para- and ortho-toluenesulfonic acid mixture is used in an amount ranging from 30 to 100 ppm based on the total amount of feed to the dehydration."

Claim 1 of auxiliary request III has the features of claim 1 of its preceding request and further requires the para-toluenesulfonic acid to ortho-toluenesulfonic acid ratio to be in the range of 2:1 to 5:1.

V. The opposition division concluded that the claimed process was not inventive over D3, which was the closest prior art. The processes of claim 1 of the patent as granted and D3 differed by the ratio of para- to ortho-toluenesulfonic acid. The available evidence did not allow concluding that the claimed process reduced corrosion and heavies or increased selectivity. The sole problem which could be considered solved was the provision of an alternative process. The claimed solution, characterised by the para- to ortho- ratio of the catalyst, would have been obvious for the skilled person in view of the lower catalyst price and document D16, which disclosed para- and ortho-mixtures as suitable catalysts for alcohol dehydration. It was thus not inventive. The conclusion was the same with respect to auxiliary requests I to III.

VI. The arguments of the appellant relevant to the issue of inventive step were as follows.

Document D3 was a suitable starting point. It disclosed a process for producing styrene using para-

toluenesulfonic acid as catalyst and addressed the problem of the formation of heavies causing fouling in the chemical plant.

The problem underlying the claimed invention was to provide a process for producing styrene with enhanced conversion and selectivity and less fouling.

The claimed solution, characterised by the para- to ortho-toluenesulfonic acid ratio, credibly solved that problem in view of D18. However, even if the board were to conclude that the problem was to be reformulated as the provision of an alternative process to produce styrene, the claimed solution would not have been obvious for a person skilled in the art and was inventive.

The arguments applied analogously to the process of claim 1 of the auxiliary requests.

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

If the claimed process were to be novel over D3, it would only differ by virtue of the ortho- to para-isomer ratio of the catalyst. No effect was linked to that difference. Neither D18 nor the data in the patent could show any advantage to it. This was confirmed by the technical report D22.

The problem underlying the claimed invention could thus only be seen as to provide an alternative process for producing styrene. The claimed solution, which consisted in using a catalyst with the specified ortho- to para- ratio, was obvious for a skilled person. The claimed process was thus not inventive. The same

arguments applied to claim 1 of the auxiliary requests.

VIII. Oral proceedings before the board of appeal took place on 10 March 2022.

IX. The final requests of the parties were as follows.

The appellant requested that the appealed decision be set aside and that the patent be maintained as granted or, alternatively, that the patent be maintained on the basis of one of the auxiliary requests I to III, filed with the statement of grounds of appeal dated 9 August 2018.

The respondent requested that the appeal be dismissed.

X. At the end of the oral proceedings, the decision was announced.

Reasons for the Decision

1. The appeal is admissible.

Inventive step

2. The parties were divided on the issue of novelty with regard to document D3. There was, however, agreement that, if the claimed process were to be considered novel, document D3 was the closest prior art. This was also the opposition division's conclusion, and the board sees no reason to differ.

There was also agreement between the parties that document D3 disclosed a process for producing styrene by dehydration of 1-phenyl ethanol in the liquid phase (abstract) which aimed at reducing the formation of

heavy by-products (column 1, lines 51 to 53). The examples of D3 were carried out with 95 ppm p-toluenesulfonic acid by weight of the feed (column 3, lines 2 to 4).

There was further agreement that, if the claimed process were to be considered novel over that of D3, it would be by virtue of requiring a para- to ortho-toluenesulfonic acid ratio in the range of 1:9 to 20:1. Inventive step is examined below on this basis.

3. Technical problem underlying the invention

The appellant defined the technical problem underlying the claimed invention as to provide a process to produce styrene with improved conversion, improved selectivity towards styrene and causing less fouling.

4. Solution

The claimed solution to this technical problem is the process of claim 1, characterised in that the catalyst has a para-toluenesulfonic acid to ortho-toluenesulfonic acid ratio in the range of 1:9 to 20:1.

5. Success

5.1 The appellant relied on the examples in the patent and on experimental evidence D18 to show that the problem as formulated above was credibly solved.

5.2 The respondent argued that these data were not conclusive. It relied on the experimental evidence filed as D22 in this respect.

The respondent further relied on experimental evidence filed with a letter dated 7 August 2020, whose admissibility was questioned by the appellant. Since the board arrived at the conclusion that the claimed process was not inventive even disregarding this data, there is no need to further elaborate on this point.

5.3 In accordance with the case law of the Boards of Appeal, in cases where comparative tests are chosen to demonstrate an inventive step with an improved effect over a claimed area, the nature of the comparison with the closest prior art must be such that the effect is convincingly shown to have its origin in the characterising features of the invention. For this purpose, it may be necessary to modify the elements of comparison so that they differ only by such characterising features (see T 197/86, OJ EPO 1989, 371, Reasons 6.1.2 and 6.1.3).

5.4 Examples 1A and 1B of the patent

Comparative Example 1A and Example 1B differ not only by the nature of the catalyst but also by its amount, which is lower in Example 1B.

The appellant argued that the results could, nevertheless, be compared as the key issue was to keep the conversion constant. Only the combination of the conversion and selectivity could show an improvement over the prior art. To keep the conversion constant, the amount of catalyst needed to be adjusted, as explained in the declaration filed as D17.

However, the amount of catalyst is not the distinguishing feature of claim 1, in fact it is not even a feature of the claim. The appellant argued that

reducing the amount of catalyst necessarily reduced the conversion, but no evidence is available in this respect. For these reasons, the examples of the patent fail to show the effect of the distinguishing feature.

5.5 Experimental evidence D18

The appellant filed before the opposition division experimental evidence D18. The results obtained are summarised in the figure in point 4. The data were obtained from an industrial plant.

The appellant acknowledged at the oral proceedings before the board that any change in the process conditions would only become evident after about ten days. D18 discloses that an effect needs two to three weeks for a change to be seen.

The yellow line in the figure corresponds to when the pTSA provider was changed. About one week later, the amount of catalyst was stepwise decreased. The feed of starting material (dark blue line labelled MBA feed) was also constantly decreased throughout the experiment.

The appellant referred to the line labelled "Conversion" (red). The fluctuation in the first part of the figure was within the usual boundaries of the process. The second part, however, showed that the conversion increased as a consequence of the change of catalyst. This was why the amount of catalyst needed to be reduced.

However, conversion, which was already increasing before the change of catalyst, started to decrease immediately after that point in time and increased

after two to four days, before the effect of the new catalyst should have been observed, following the appellant's own argument. The conversion continued to increase afterwards and decreased before the effect of the reduction of the amount of catalyst should have been noticeable. In addition, the feed of starting material was continuously reduced throughout the experiment. No effect can thus be linked only to the distinguishing feature.

5.6 Experimental evidence D22

D22 discloses a series of experiments on a laboratory scale. Conversion and formation of heavies were measured with a catalyst according to claim 1 and with a catalyst having a ratio of para- to ortho-toluenesulfonic acid outside the boundary set by claim 1. Two series of experiments were carried out, at two different temperatures (160°C and 180°C). The curves in Figures 2 to 5 reflect the results obtained.

No difference in result is apparent between the processes using the different catalysts.

5.7 In summary, the examples in the patent and D18 do not allow a direct comparison with the closest prior art since they do not differ from one another solely by virtue of the distinguishing feature of the claimed invention. D22, on the contrary, shows that no difference was achieved under the conditions tested.

5.8 The appellant argued that in view of the diverging results, the patentee should be given the benefit of doubt, and the purported effect should be recognised. It relied in this respect on T 547/88 (Reasons, 9 and 10).

However, the facts of the current case differ. In the case underlying T 547/88, the board was facing contradictory experimental evidence.

In the case at issue, however, there is experimental evidence showing the lack of an effect (D22) and inconclusive evidence aiming at showing the opposite (examples of the patent, D18). Thus, the board's conclusions in T 547/88 do not apply.

The benefit of doubt cannot be given to the appellant, which has not shown the alleged effect arising from the distinguishing feature, whereas the respondent, on the contrary, has provided proof that no effect occurs.

This argument is thus not convincing.

5.9 It is thus not credible that the problem as defined above in point 3. above is solved by the process of claim 1.

6. Reformulation of the technical problem

In accordance with the case law, alleged but unsupported advantages cannot be taken into consideration in determining the problem underlying the invention (see e.g. decision T 20/81, OJ EPO 1982, 217, Reasons 3, last paragraph).

As the alleged improvement in terms of enhanced conversion and selectivity and reduced fouling lacks the required supporting evidence, the technical problem as defined above needs to be reformulated.

In view of D3, it can only be seen in providing an

alternative process for obtaining styrene by dehydrating 1-phenylethanol.

It was not disputed that this technical problem has been solved by the process of claim 1.

7. It thus remains to be decided whether the proposed solution would have been obvious for the skilled person in view of the prior art.

7.1 The appellant did not dispute that mixtures of ortho- and para-toluenesulfonic acid as required by claim 1 were commercially available before the filing date of the patent. Its own experimental evidence D18 discloses the change to a "new pTSA provider" in 2007 (figure in point 4, in yellow). D9 discloses that the product CELESAL PTS, having the composition required by claim 1, was produced before the filing date.

Para-toluenesulfonic acid is a known catalyst of the process (D3 and D5). Commercially available mixtures of ortho- and para-toluenesulfonic can contain ca. 80% of the latter (D9).

The skilled person, seeking an alternative, would have considered commercially available mixtures whose main component is the known catalyst para-toluenesulfonic acid as suitable alternatives to para-toluenesulfonic acid alone. In doing so, they would have arrived at the claimed invention without requiring inventive skill.

7.2 Furthermore, document D5 discloses that suitable catalysts of the process are "mineral acids, organic sulfonic acids and carboxylic acids" (column 2, lines 57 to 58). Also, D3 discloses that the process is catalysed by acids (column 2, first paragraph). Both

para- and ortho-toluenesulfonic acids contain an aromatic sulfonic acid moiety. The skilled person would also have expected the ortho-isomer to catalyse the process given its similarity.

- 7.3 The appellant argued that Table III of D5 disclosed catalysts which performed better than para-toluenesulfonic acid (runs 7 and 11). D5 thus hinted at these better-performing catalysts; not at a mixture of toluenesulfonic acid isomers.

However, it is irrelevant whether other catalyst would also be considered as (non-obvious) alternatives. The issue under inventive step is whether the skilled person would have chosen the isomer mixture required by claim 1. The board considers it to be the case for the reasons in 7.1 and 7.2.

- 7.4 The respondent and the opposition division also relied on the disclosure of document D16. D16 discloses both para-toluenesulfonic acid and mixtures of ortho- and para-isomers (column 2, lines 66 to 68) as catalysts for the dehydration of tertbutanol.

The appellant argued that the reaction in D16 related to a different alcohol, which was not aromatic. The skilled person would thus not have considered the teaching of D16.

However, D16 only corroborates the board's conclusion that the skilled person would have considered both isomers to have a similar reactivity in these type of processes.

- 7.5 The process of claim 1 of the patent as granted is thus not inventive (Article 56 EPC), and the ground for

opposition pursuant to Article 100(a) EPC precludes the maintenance of the patent as granted.

8. Auxiliary requests

8.1 The issue of inventive step does not differ with respect to claim 1 of the auxiliary requests on file. This was undisputed.

8.2 The mixtures such as that of D9 containing 80% of para-toluenesulfonic acid are required by claim 1 of all the auxiliary requests.

8.3 Document D3 discloses the use of 95 ppm of catalyst. The relative amount of catalyst being between 30 to 100 ppm (auxiliary requests II and III) thus does not add any further distinguishing feature over D3.

8.4 None of the auxiliary requests is allowable (Article 56 EPC).

9. Having regard to the board's negative conclusion on inventive step, it is not necessary to decide on other disputed issues.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



C. Rodríguez Rodríguez

P. Gryczka

Decision electronically authenticated