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Datasheet for the decision of 16 June 2011

Case Number: T 0443/09 - 3.3.10

Application Number: 03292023.3

Publication Number: 1396483

IPC: C07C 41/09

Language of the proceedings: EN

Title of invention:
Process for producing dimethyl ether

Patentee:
TOYO ENGINEERING CORPORATION

Opponent:
SÜD-CHEMIE AG

Headword:
Process for producing dimethyl ether/TOYO ENGINEERING

Relevant legal provisions:
EPC Art. 54, 56, 114(2)

Keyword:
"Late-filed evidence in relation to the Appellant's prior use: (not admitted into the appeal proceedings) - insufficiently substantiated"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
T 0300/86, T 0270/90, T 0877/90, T 0228/91, T 0836/02, T 0823/96, T 0355/97, T 0508/00, T 0681/00, T 0176/04, T 0555/04

Catchword:
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Case Number: T 0443/09 - 3.3.10

D E C I S I O N
of the Technical Board of Appeal 3.3.10
of 16 June 2011

Appellant: (Opponent)
SÜD-CHEMIE AG
Lenbachplatz 6
D-80333 München (DE)

Representative:
Stolmár, Matthias
Stolmár Scheele & Partner
Patentanwälte
Blumenstrasse 17
D-80331 München (DE)

Respondent: (Patent Proprietor)
TOYO ENGINEERING CORPORATION
2-5, Kasumigaseki 3-chome
Chiyoda-ku
Tokyo (JP)

Representative:
Rocaboy, Nadine and Nieman, Frédéric
Cabinet Plasseraud
52 rue de la Victoire
F-75440 Paris Cedex 09 (FR)

Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 10 December 2008 concerning maintenance of European patent No. 1396483 in amended form.

Composition of the Board:

Chairman: J. Mercey
Members: J.-C. Schmid
D. S. Rogers

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal against the interlocutory decision of the Opposition Division which found that the European patent No. 1 396 483 in the form as amended during opposition proceedings according to the then pending single auxiliary request met the requirements of the EPC.

Independent claim 1 of this request read as follows: "A process for producing dimethyl ether comprising dehydrating methanol in vapor phase at a reaction temperature of 250°C to 350°C and a gas hourly space velocity (GHSV) of 900 h^{-1} to 4000 h^{-1} and a pressure of at least 0.0 MPa-G and at most 3.0 MPa-G in the presence of an activated alumina catalyst having an average pore radius of at least 2.5 nm and less than 5 nm and having a sodium oxide content of at most 0.07 % by weight, and collection of dimethyl ether produced."

II. Notice of opposition had been filed by the Appellant requesting revocation of the patent-in-suit in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC). *Inter alia* the following documents were submitted in the opposition proceedings:

(5) JP-A-S59-199647, English translation,
(6) JP-A-S59-141532, English translation,
(7) Ind. Eng. Chem., Prod. Res. Dev. 15, (1976), pages 234-241, and
(8) JP-A-03-056433, English translation filed on 16 October 2008.

III. In the decision under appeal, the Opposition Division considered that document (8) was the closest prior art. The technical problem underlying the patent-in-suit was the provision of an improved process for the synthesis of dimethyl ether. Although documents (5), (6) and (7) mentioned that the sodium content of the alumina catalyst should be as low as possible, there was no hint in the prior art indicating that the average pore radius must be selected within the claimed range in order to achieve higher methanol conversion. Hence it came to the conclusion that the subject-matter of claim 1 of the auxiliary request involved an inventive step.

IV. With the statement setting out the Grounds of Appeal, the Appellant *inter alia* filed documents:

(10) B. L. Bhatt, "Synthesis of dimethyl ether and alternative fuels in the liquid phase from coal-derived synthesis gas", Fossil, September 1992, and

(11) "Eidesstattliche Versicherung" of Mr. G. Selig, including annexes A1 to A10.

During the oral proceedings held before the Board on 16 June 2011, the Appellant no longer maintained its objection based on the new ground of opposition, namely insufficiency of disclosure.

The Appellant argued that the subject-matter of claim 1 lacked novelty over the prior use of the catalyst T-126 as reported in annex A10 (copy of a letter dated 3 April 1990 emanating from Prof. Dr. Levec and addressed to Dr. K. H. Stadler). Prof. Dr. Levec was

not a consultant for Süd-Chemie and there was no confidentiality agreement. The process for producing dimethyl ether by dehydrating methanol in the vapour phase as reported in the letter was carried out at Ljubljana University prior to 3 April 1990 and was accessible to any students present at the university at that time. Despite extensive research, it was not possible to find Prof. Dr. Levec, nor to establish whether his laboratory in the university still existed. The affidavit of Mr. G. Selig (document (11)) furthermore attested that the product designation T-126 was synonym to the designations Girdler T-126, DME-1; T-4021, CTR, CTR-Träger and DME/T-4021. The late-filing of these documents was due to the difficulty of retrieving old documentation in a big company such as Süd Chemie after twenty years and several moves.

The subject-matter of claim 1 also lacked novelty over document (8). Alumina with a sodium oxide content of at most 0.07% by weight was implicitly disclosed in document (8), since the skilled person was aware that the presence of sodium oxide was detrimental to the catalytic activity. Hence, when carrying out the process of document (8), the skilled person would have employed alumina having a very low sodium oxide content. There was also an overlap with the average pore radius range of the alumina disclosed in document (8). This was calculated from the specific surface area range and the pore volume range of the alumina. Accordingly document (8) disclosed all the features of the claimed process.

Document (8) was the closest prior art. The technical problem underlying the patent-in-suit, identified by

the Respondent as being to improve the methanol conversion, was not solved by the claimed process. Methanol conversions of 82.6% and 81.6% were obtained in examples 1 and 2 of document (8), whereas the methanol conversion of the claimed processes according to experiments 1 to 3 filed by the Respondent with the letter dated 12 August 2008 was lower. Furthermore, the comparison did not show that the choice of alumina having the claimed average pore radius increased the methanol conversion. The choice of this parameter was purely arbitrary. Other parameters of the alumina, such as the content of sodium oxide or the specific surface area, influenced the methanol conversion. There was no trend emerging from the results clearly showing that decreasing the average pore radius caused higher methanol conversion. This was highlighted by the comparison of examples 2 and 3. The process of example 2, which was carried out with alumina having a lower average pore radius and containing even less sodium oxide than the alumina used in the process of example 3, had the lowest methanol conversion. Documents (7) and (10) taught that sodium oxide was detrimental to the catalytic activity and thus gave a clear incentive for the skilled person to employ alumina with the lowest sodium content in order to favour the methanol conversion. Furthermore, document (8) taught that catalysts with a large pore radius were lacking in mechanical strength. Hence, the skilled person would have chosen a catalyst with a lower average pore radius to get a mechanically stable catalyst, e.g. that disclosed in document (10). That document was concerned with the production of dimethyl ether in the liquid phase. The catalyst A, i.e. Catapal, was that used in the patent-in-suit and was more

efficient than the other catalysts disclosed in document (10).

V. According to the Respondent, the alleged lack of disclosure was a new ground of opposition and hence not admissible.

With regard to the alleged prior use, the late-filed documents (10) and (11) were *prima facie* not highly relevant documents and should thus be disregarded for the assessment of novelty and inventive step. Since practically all evidence in support of the alleged prior use laid within the power of the Appellant, it had to prove the alleged prior use up to the hilt. However, the availability to the public of the experiment described in annex A10 of document (11) was not established. Furthermore there was no evidence that the sample of alumina T-126 used in the report met the requirements of the alumina according to claim 1, since neither the average pore size nor the sodium content of the alumina was constant from one sample to another.

Furthermore, the subject-matter of claim 1 was novel over document (8), since this document did not disclose any sodium oxide content, nor an average pore radius of less than 5 nm, of the alumina catalyst.

Document (8) was the closest prior art. The technical problem underlying the invention was the provision of an improved process for producing dimethyl ether in terms of a higher conversion of methanol. The solution was to use an alumina as catalyst having a sodium oxide content of at most 0.07 % by weight and an average pore radius of at least 2.5 and less than 5 nm. The

comparison between example 4 and comparative example 2 in table 1 on page 7 of the patent-in-suit showed that an activated alumina having a sodium oxide content of at most 0.07% by weight improved the methanol conversion. The results of examples 2 to 5 of the comparative tests filed with the letter dated 12 August 2008 showed that the average pore radius was critical for the methanol conversion and that catalysing the reaction with an alumina with an average pore radius within the claimed range increased the methanol conversion. This improvement could not be expected in the light of the prior art, since an average pore radius of at least 5 nm was an essential feature of document (8). Furthermore, the teaching of a process for producing dimethyl ether from methanol in the gas phase could not be combined with the teaching of document (10), which concerned the synthesis of dimethyl ether from coal-derived syngas (CO and H_2) in a single slurry or liquid phase process, i.e. implying very different reaction conditions.

VI. The Appellant requested that the decision under appeal be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed.

VII. At the end of the oral proceedings before the Board, the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

2. *Late-filed evidence with respect to an alleged public prior use (Article 114(2) EPC)*

Document (11) and its annexes A1 to A10 are new evidence cited for the first time in the Appellant's Statement of the Grounds of Appeal. The Respondent objected to these documents being admitted into the proceedings for the reason that they were late-filed non-relevant documents.

2.1 According to the established jurisprudence of the Boards of Appeal, the relevance of the late-filed evidence is a crucial criterion for deciding on its admissibility in the proceedings. However, other criteria are important, such as how late, whether the late submission of evidence constitutes an abuse of proceedings, or if their admission excessively delays the proceedings (see T 681/00, point 2 of the reasons; T 555/04, point 1 of the reasons; none published in OJ EPO). Thus, the Boards of Appeal, making use of their discretion under Article 114(2) EPC in order to ensure fair and prompt proceedings, are entitled to refuse to take them into account.

2.2 In the appeal proceedings the Appellant relied on a new alleged public prior use based on trials of dehydration of methanol by Prof. Dr. Levec, which allegedly had been made available to the public in the years 1989 and 1990 in the Department of Chemistry and Chemical Technology at the University Edvard Kardelj, Ljubljana, Slovenia.

The sole evidence filed by the Appellant supporting this alleged public prior use is a letter dated 3 April

1990 sent by Prof. Dr. Levec to the Appellant's employee Dr. Stadler including the results of methanol conversion trials with a catalyst denoted as T-126 (annex A10).

2.3 In connection with why the documents in support of the prior use were late-filed, the Appellant argued that this was due to the difficulty in retrieving documentation in a large company such as Süd Chemie after such a long period of time. Furthermore, it was not to be expected that documents connected with projects which had been concluded 20 years ago to be archived for such a long time.

However, the Appellant's difficulties in finding documents within its own company is a self-created situation lying entirely within its own sphere of responsibility, which is not a reason to justify the admission of the late-filed documents purportedly showing a prior use (cf. T 508/00, point 5.2, not published in OJ EPO). Furthermore, the Board holds that of course the Appellant is under no obligation to archive old projects. However, if it wishes to prove a prior use based on such a project, then it is the Appellant's duty to furnish the relevant documents in due time.

2.4 With regard to the relevance of the late-filed documents, it needs to be established whether they are *prima facie* adequate to substantiate the alleged public prior use. In order to prove a public prior use, the date on which the prior use occurred has to be established, the circumstances surrounding the prior use and what was made available to the public.

2.4.1 Regarding the question of when the prior use was made available to the public, the Appellant merely indicated that it was prior to the letter (Annexe 10) dated 3 April 1990, but was unable to indicate a precise date.

2.4.2 The circumstances surrounding the prior use are also not established in this letter. The Appellant merely alleged that that there was no obligation of confidentiality, in particular that Prof. Dr. Levec was not a consultant of Süd Chemie, but was unable to indicate the reasons why this report was sent to Süd Chemie.

2.4.3 Regarding the question of how the prior use was made available to the public, the Appellant argued that students present at the University Edvard Kardelj at the time in question had access to the results of the methanol conversion trials. It further argued that according to decisions T 228/91, T 300/86, T 877/90 (none published in the OJ EPO), research carried out at a university is always considered as being available to the public.

A prior use should be regarded as made available to the public if, at the relevant date, it was possible for members of the public to gain knowledge of the particular use and there was no bar of confidentiality restricting the use or dissemination of such knowledge (see T 300/86, point 2.1, *loc. cit.*).

In the present case, no evidence has been provided that the letter from the university professor to the employee of the Appellant (annex A10) was available to

the public. In the absence of such evidence, the Board holds that such a letter must *prima facie* be treated as a private communication. The Appellant has also provided no evidence that students at the University Edvard Kardelj had access to the results of the methanol conversion trials in question. The mere statement by an employee of the Appellant, Mr. Selig (see document (11), point 5) that the results of the methanol conversion trials were publicly available is not supported by any arguments or evidence as to how, where, when, and to whom they were accessible.

With regard to the cited decisions which apparently show that the Boards of Appeal always consider research carried out at universities to be *per se* available to the public, none of these decisions is in fact concerned with a prior use based on experiments carried out at a university. In any case, the availability to the public of a prior use must always be evaluated according to the particular circumstances of the case. In the present case, the circumstances surrounding the experiments carried out by Prof. Dr. Levec have not been made clear.

2.4.4 Hence, the Board must come to the conclusion that the accessibility of the alleged public prior use by members of the public is not clearly established.

2.5 In view of the above, the Board considers that the alleged public prior use, as relied upon in the Appellant's Statement of the Grounds of Appeal, is not substantiated. Thus, it is not necessary to determine whether the alumina denoted T-126 used in the trials as reported in annex 10 meets the requirement of the

alumina set forth in claim 1, which the Respondent had alleged it did not (see point V above).

2.6 The submissions made by the Appellant in respect of the public prior use shall therefore be disregarded under Article 114(2) EPC.

3. *Amendments*

The amendments to claim 1 find their basis in the application as filed on page 11, lines 14 to 16 (reaction temperature of 250°C to 350°C); on page 11, lines 18 to 23 (GHSV of 900 h^{-1} to 4000 h^{-1}); claim 6 (pressure of at least 0.0 MPa-G and at most 3.0 MPa-G); on page 5, lines 24 and 25 (an average pore radius of at least 2.5 nm and less than 5.0 nm); and on page 12, line 4 (collection of dimethyl ether produced). These amendments restrict the protection conferred by the granted patent. Therefore, there are no objections to the amendments made in present claim 1. This finding was not contested by the Appellant.

Dependent claim 7 has been renumbered in view of the deletion of dependent claim 6.

The requirements of Article 123(2) and (3) EPC are thus satisfied.

4. *Novelty*

4.1 Document (8) discloses a process for producing dimethyl ether comprising dehydrating methanol in the vapour phase at a reaction temperature of 200°C to 400°C and a gas space velocity (GHSV) of 500 h^{-1} to 10000 h^{-1} under a

pressure of 1 to 20 kg/cm^2 in the presence of an alumina catalyst having a surface area of 210 to 300 m^2/g, a volume of pores of 0.6 to 0.9 ml/g and an average pore radius of 5.0 to 10 nm (page 4, lines 1 to 4 and 18 to 23).

4.2 The Appellant submitted that a sodium oxide content of at most 0.07% by weight was implicitly disclosed in document (8), since the skilled person would choose an alumina having a very low content of sodium oxide in order to improve its catalytic activity.

The Board observes that to find a lack of novelty, there must be a direct and unambiguous disclosure, either explicit or implicit, in the state of the art which would inevitably lead the skilled person to subject-matter falling within the scope of what is claimed. In this context "implicit disclosure" means disclosure which any person skilled in the art would objectively consider as necessarily implied in the explicit content, e.g. in view of general scientific laws. In this respect, the term "implicit disclosure" should not be construed to mean matter that does not belong to the content of the technical information provided by a document but may be rendered obvious on the basis of that content. Whilst common general knowledge must be taken into account in deciding what is clearly and unambiguously implied by the explicit disclosure of a document, the question of what may be rendered obvious by that disclosure in the light of common general knowledge is not relevant to the assessment of what is implied by the disclosure of that document. The implicit disclosure means no more than the clear and unambiguous consequence of what is

explicitly mentioned (see T 823/96, point 4.5 of the reasons, not published in OJ EPO).

In the present case, the disclosure in document (8) of dehydrating methanol in the presence of alumina does not implicitly disclose a sodium oxide content of at most 0.07% by weight, since although the skilled person may have known that sodium oxide was detrimental to the catalytic activity, dehydrating methanol in the presence of alumina does not inevitably result in using an alumina with a sodium oxide content of at most 0.07%, such a content being simply the result of the choice of a particular alumina, on which document (8), however, is silent.

4.3 The Appellant argued that there was an overlap between the claimed range and the range of the average pore radius of the alumina disclosed in document (8), which could be calculated from the disclosed ranges of the pore volume and specific surface area according to the formula 1 of the specification of the patent-in-suit (see page 3).

However, the dehydration process disclosed in document (8) is carried out with an alumina which should meet three criteria, i.e. a surface area of 210 to 300 m^2/g, a volume of pores of 0.6 to 0.9 ml/g and an average pore radius of 5.0 to 10 nm.

In particular, document (8) specifically requires an average pore radius falling within the range of 5.0 to 10 nm. That means that the surface area and the volume of pores of the alumina shall be selected from within the disclosed ranges of 210 to 300 m^2/g and 0.6 to

0.9 ml/g, respectively, to meet that third criterion, i.e. an average pore radius within the range of 5.0 to 10 nm. As claim 1 requires an average pore radius of less than 5 nm, i.e. which is outside the range required in document (8), the Board cannot concur with the Appellant's point that there is an overlap in average pore radius range.

4.4 Since claim 1 contains the features that the alumina has an average pore radius of less than 5 nm and a sodium oxide content of at most 0.07 % by weight, document (8) not disclosing said features, neither explicitly nor implicitly, the Board concludes that the subject-matter of claim 1 is novel within the meaning of Article 54 EPC.

5. *Inventive step*

In accordance with the "problem-solution approach" applied by the Boards of Appeal to assess inventive step on an objective basis, it is in particular necessary to establish the closest state of the art, to determine in the light thereof the technical problem which the claimed invention addresses and successfully solves, and to examine the obviousness of the claimed solution to this problem in view of the state of the art.

5.1 *Closest prior art*

The Board considers, in agreement with the Parties and the Opposition Division, that document (8) represents the closest state of the art, and, hence, takes it as the starting point for the assessment of inventive step.

5.2 *Problem underlying the patent-in-suit*

The Respondent submitted that the technical problem underlying the patent-in-suit was to provide an improved process for producing dimethyl ether in terms of a higher conversion of methanol.

5.3 *Solution*

As a solution to this problem the patent-in-suit proposes the process according to claim 1 which is characterized by the catalyst being an alumina having a sodium oxide content of at most 0.07% by weight and an average pore radius of at least 2.5 and less than 5 nm.

5.4 *Success*

5.4.1 *Sodium oxide content threshold of at most 0.07% by weight*

The Appellant did not contest that the methanol conversion is improved when using an alumina having a very low content of sodium oxide. On the contrary, it submitted that it was known, e.g. from documents (7) and (10), that the amount of sodium oxide in the activated alumina should be as low as possible in order not to decrease its catalytic activity. In other words, the lower the content of sodium oxide, the higher is the catalytic activity of the alumina and thereby the methanol conversion.

The Board is thus satisfied that operating the process in the presence of an activated alumina having a very

low sodium oxide content, i.e. below the threshold of at most 0.07 wt%, contributes to improving the methanol conversion.

5.4.2 *Average pore radius of at least 2.5 and less than 5 nm*

In order to demonstrate that operating the dehydration process with alumina having an average pore radius of at least 2.5 and less than 5 nm improved the methanol conversion, the Respondent relied on the experimental results filed with the letter dated 12 August 2008.

These experiments relate to a process for producing dimethyl ether by dehydration of methanol in the presence of an activated alumina catalyst at 285°C under atmospheric pressure at GHSV of $1700h^{-1}$. The process of experiment 2 differs from that of comparative experiment 5 essentially by virtue of the nature of the alumina used as the catalyst. Experiment 2, wherein the process is carried out in the presence of alumina having an average pore radius of 4.0 nm is a process according to the patent-in-suit. Comparative experiment 5, wherein the alumina has an average pore radius of 6.6 nm, reflects the closest prior art.

The process described in experiment 2 achieves a methanol conversion of 71.6%, whereas only 60.3 % methanol conversion is obtained with the process of comparative experiment 5.

These results demonstrate that the process for the dehydration of methanol carried out in the presence of alumina having an average pore radius of 4.0 nm, i.e.

within the claimed range, provides higher methanol conversion than that according to the closest prior art carried out in the presence of alumina having an average pore radius of 6.6 nm.

Hence, it is credible that the claimed process operated in the presence of alumina having an average pore radius of at least 0.5 and less than 5 nm has higher methanol conversion than that according to the closest prior art, document (8), operated in the presence of alumina having an average pore radius of from 5 to 10 nm.

The Board is thus satisfied that the technical problem as defined above is solved by the claimed process.

5.4.3 The Appellant challenged the success of the claimed solution arguing that the comparison of experiments 2 and 5 was not fair, since the alumina of comparative experiment 5 reflecting the prior art had a lower sodium oxide content than the alumina of experiment 2, reflecting the invention of the patent-in-suit.

It is a fact that the alumina used in experiment 2 contains slightly more sodium oxide than the alumina according to the comparative experiment 5 (0.033 wt% as compared to 0.03 wt%). However this finding merely supports the effect of improved methanol conversion shown by this comparison, since the improvement is achieved in experiment 2 according to the invention in spite of the higher sodium oxide content, which is known to hinder methanol conversion (see point 5.4.1 above).

For these reasons, and in the absence of any evidence to the contrary, it is credible that the methanol conversion is increased by using alumina having an average pore radius of at least 0.5 and less than 5 nm rather than by using the alumina of the closest prior art document (8).

5.4.4 According to the Appellant, no problem was solved with respect to document (8), since the process of example 1 of document (8) already achieved a methanol conversion of 82.6%, which was higher than that obtained by processes according to the patent-in-suit, in particular higher than the 71.6% of methanol conversion obtained in the experiment 2.

However, in the case 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 state of the art must be such that the effect is convincingly shown to have its origin in the characterizing features of the invention. In the present case, the Respondent has convincingly demonstrated a causal link between the improvement and the average pore radius of at least 0.5 and less than 5 nm of the alumina, which is sufficient to show that the problem underlying the patent-in-suit is successfully solved. Accordingly, the Appellant's argument, which is based on a comparison where more parameters than only the characterizing features have been varied, is not relevant and, hence, must be rejected.

5.4.5 Lastly, the Appellant argued that the claimed range was purely arbitrary, since there was no clear trend emerging from the results of the experiments. The

effect on the methanol conversion of the average pore radius was not linear, as highlighted by the comparison of experiments 2 and 3 showing that an alumina having an average pore radius of 4.9 nm provides higher methanol conversion than one having an average pore radius of 4.0 nm, with the consequence that there was no proof that the technical problem was solved across the whole range claimed.

However both experiments 2 and 3 are according to the invention and provide much better methanol conversion than experiment 5 reflecting the closest prior art (71.6% and 71.7% compared to 60.3%). Hence, the Board sees no reason to doubt that the effect of higher methanol conversion would be achieved across the claimed range, even if there were a slight decrease of this effect towards the lowest limit of 2.5 nm of the claimed range.

According to the established jurisprudence of the Boards of Appeal, each of the parties to the proceedings carries the burden of proof for the facts it alleges. If a party, whose arguments rest on these alleged facts, does not discharge its burden of proof, this goes to the detriment of that party and such a party may not shift the onus of proof onto the other party (see T 270/90, OJ EPO 1993, 725, point 2.1 of the reasons; T 355/97, point 2.5.1 of the reasons; T 836/02, point 4.5 of the reasons; T 176/04, point 5.6.3 of the reasons; all but T 270/90 not published in OJ EPO).

The Appellant has not filed corroborating evidence for its allegation of non-achievement of the effect with an alumina having an average pore radius within the

claimed range, but merely expressed doubts and, hence, has not discharged its burden of proof, with the consequence that these unsubstantiated doubts are not to be taken into account by the Board.

5.4.6 Consequently, the Board is satisfied that the technical problem underlying the patent-in-suit of providing an improved process in terms of a higher methanol conversion has been successfully solved by the process according to claim 1, characterized by the presence of an alumina having a sodium oxide content of at most 0.07% by weight and an average pore radius of at least 2.5 and less than 5 nm.

5.5 *Obviousness*

5.5.1 *Inter alia* document (7) discloses that sodium oxide is detrimental to the catalytic activity of alumina when used in the dehydration of methanol to dimethyl ether (see paragraph bridging pages 239 and 240). This alone is a clear incentive for the skilled person to employ alumina with the lowest content of sodium in order to favour the methanol conversion. Thus, the sodium oxide content threshold as indicated in the claim, namely of at most 0.07% by weight, does not confer any inventiveness to the claimed subject-matter.

This finding was not contested by the Respondent which indicated that the inventive step did not so much reside in the low sodium oxide content of the alumina, but rather in its combination with an average pore radius of at least 2.5 nm and less than 5 nm.

5.5.2 Hence, it remains to be decided whether or not it was obvious in the light of the prior art to carry out the process with an alumina having an average pore radius of at least 2.5 and less than 5 nm, instead of that described in document (8) requiring an average pore radius in the range of 5 to 10 nm, in order to improve the methanol conversion.

5.5.3 The method for producing dimethyl ether by dehydration of methanol in the presence of alumina disclosed in document (8) requires that the alumina has an average pore radius of 5 to 10 nm (see claim 1, page 4, lines 1 to 4). Consequently, for this simple reason, document (8) does not point to the claimed solution, which is characterized by the use of an alumina having an average pore radius of at least 2.5 to less than 5 nm, i.e. outside the range required by document (8).

5.5.4 According to the Appellant, document (8) on page 2, penultimate line to page 3, line 5, taught against the use of alumina with a large pore radius, since this was detrimental to the catalyst's mechanical strength. The skilled person would thus have reduced the size of the pore radius of the alumina taught by document (8) and thereby have automatically arrived at the proposed solution.

The Appellant's argumentation implies as a prerequisite that the skilled person would have taken this passage of document (8) into consideration in order to solve the problem underlying the invention, However, the mechanical strength of alumina has not been shown to be linked to its catalytic activity, such that improvement of the former does not automatically lead to

improvement of the latter. In any case, the passage in question forms part of the description of the prior art at the time of the invention to which document (8) pertains. However, document (8) itself already overcomes the drawbacks associated with the relation between the physical properties and catalytic activity of alumina catalysts addressed in the prior art section therein (see the paragraph bridging pages 2 and 3) by using an alumina catalyst with an average pore radius of 5 to 10 nm. Thus document (8) cannot be considered to teach away from using an alumina catalyst having such a pore radius (see also point 5.5.3 above), so that this argument cannot convince the Board.

5.5.5 The Appellant further relied on document (10) disclosing an activated alumina, namely catalyst A, having an average pore radius within the claimed range, in combination with the disclosure of document (8).

Document (10) is concerned with the synthesis of dimethyl ether in the liquid phase from coal-derived gas. Table 2 on page 23 summarizes the properties of various dehydration catalysts, in particular the average pore diameter. The catalyst A, named Catapal Gamma Lab-500, is disclosed in table 2 to have a BET surface area of 223 m^2/g, a total pore volume of 0.41 cc/g and an average pore diameter of 9.4 nm, and has the highest activity of all the catalysts disclosed in said document. Since this document, however, relates to the liquid phase dehydration of methanol, it is questionable whether the skilled person would have considered its content at all when seeking a solution to the problem of improving the vapour phase dehydration of methanol, as different interactions

between reactants and catalyst in the gas and liquid phases would be expected, and very different reaction conditions for the two types of reaction are used. In any case, this document does not teach which of the properties summarized in table 2 explains the significantly higher activity of catalyst A compared to the rest of the catalysts listed in table 2, but merely speculates that the higher activity may be due to its higher purity.

Hence document (10) does not provide the skilled person with the incentive to replace the alumina catalyst of document (8) by one having an average pore radius of at least 2.5 nm and less than 5nm in order to increase the methanol conversion.

Accordingly, the claimed subject-matter is not rendered obvious by the combination of document (8) with document (10).

5.5.6 In respect of obviousness, the Appellant did not rely on any further documents and the Board is not aware of further documents relevant in this respect. Thus, the Board is satisfied that none of the other documents in the proceedings renders the proposed solution obvious.

5.6 Therefore, the subject-matter of claim 1, and for the same reasons, that of the dependent claims, involves an inventive step within the meaning of Article 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar | The Chair

C. Rodríguez Rodríguez | J. Mercey