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## Datasheet for the decision
## of 7 March 2024

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| **Case Number:** | T 1490/21 - 3.3.06 |
| **Application Number:** | 06760706.9 |
| **Publication Number:** | 1890807 |
| **IPC:** | B01J23/66, B01J35/10,<br>C07D301/10 |
| **Language of the proceedings:** | EN |

**Title of invention:**
A CATALYST, A PROCESS FOR PREPARING THE CATALYST, AND A PROCESS FOR THE PRODUCTION OF AN OLEFIN OXIDE, A 1,2-DIOL, A 1,2-DIOL ETHER, OR AN ALKANOLAMINE

**Patent Proprietor:**
Shell Internationale Research Maatschappij B.V.

**Opponents:**
BASF SE
Scientific Design Company, Inc

**Headword:**
Shell/Pore size distribution

**Relevant legal provisions:**
EPC Art. 56

**Keyword:**
Inventive step - (no) - obvious alternative

**Decisions cited:**

**Catchword:**

Europäisches Patentamt
European Patent Office
Office européen des brevets

**Beschwerdekammern**

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**Chambres de recours**

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**Case Number: T 1490/21 - 3.3.06**

# DECISION
## of Technical Board of Appeal 3.3.06
## of 7 March 2024

**Appellant:**
(Patent Proprietor)
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**Representative:**
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**Respondent:**
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**Respondent:**
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**Representative:**
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81543 München (DE)

**Decision under appeal:**
**Decision of the Opposition Division of the European Patent Office posted on 30 July 2021 revoking European patent No. 1890807 pursuant to Article 101(3)(b) EPC.**

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | J.-M. Schwaller |
| **Members:** | S. Arrojo |
| | R. Cramer |

## Summary of Facts and Submissions

I. The patent proprietor filed an appeal contesting the decision of the opposition division to revoke European patent No. 1 890 807 for non-compliance with the requirements of inventive step in view of **D1** (EP 0 393 785 A1) or **D13** (EP 0 480 538 A1) combined with **D17** (US 5,733,842), extension beyond the content of application as filed and lack of clarity.
**D2** (US 2003/0162984 A1), **D4** (US 4,761,394),
**D14** (US 2003/0162655 Al) or **D15** (US 4,908,343) were also cited as possible starting points.

II. With its grounds of appeal filed on 9 December 2021, the appellant contested the decision and filed 27 amended sets of claims as auxiliary requests 1 to 27, with all requests corresponding to those submitted during first instance proceedings in a different order. Further, it filed in particular appendixes 2 to 5 including additional experimental evidence and documents D27 and D28.

III. In their replies, opponents 1 and 2 - also respondents - requested that documents D27 and D28, appendixes 2 to 5 and the new lines of defence allegedly introduced for the first time in the grounds of appeal not be admitted to the proceedings. With these replies, the respondents also filed new documents D29 to D32.

IV. In response to the Board's preliminary opinion that none of the requests on file appeared to meet the requirement of inventive step, at least in respect of D1 in combination with D17, the appellant filed a new auxiliary request 28 in a submission dated 12 January 2024.

V. At the oral proceedings, which took place on 7 March 2024, the appellant in particular filed a new main request and auxiliary requests 1 to 3, corresponding to the 3rd, 10th, 13th and 28th auxiliary requests on file, and withdrew the other pending requests. At the end of the proceedings, it also withdrew auxiliary request 3.

Claim 1 of the **main request** reads as follows:

*"1. A catalyst comprising a carrier and silver deposited on the carrier, wherein the catalyst has been obtained by a process comprising:*

*a) selecting a carrier which has a surface area in the range of from 1.5 $m^2/g$ to 2 $m^2/g$, as determined by the nitrogen BET method, a median pore diameter, as measured by mercury intrusion porosimetry to a pressure of 2.1 $x10^8$ Pa with 130° contact angle, mercury with a surface tension of 0.480 N/m, and correction for mercury compression applied, of more than 0.8 µm, and a pore size distribution, as measured by mercury intrusion porosimetry to a pressure of 2.1 $x10^8$ Pa with 130° contact angle, mercury with a surface tension of 0.480 N/m, and correction for mercury compression applied, wherein at least 80 % of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 µm and at least 80 % of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 µm is contained in pores with diameters in the range of from 0.3 to 10 µm, and*

*b) depositing silver on the carrier*

*wherein the carrier comprises alumina and a bond material,*

*wherein the carrier has an α-alumina content of at least 95 weight percent, and wherein the bond material comprises an alkaline earth metal silicate bond material, and* *wherein the catalyst comprises rhenium deposited on the carrier in addition to silver."*

Claim 1 of **auxiliary request 1** reads as follows:
*"1. A catalyst comprising a carrier and silver deposited on the carrier, wherein the catalyst has been obtained by a process comprising:*
*a) selecting a carrier which has a surface area in the range of from 1.5 m2/g to 2 m2/g, as determined by the nitrogen BET method, a median pore diameter, as measured by mercury intrusion porosimetry to a pressure of 2.1 x$10^8$ Pa using a Micromeretics Autopore 9200 model with 130° contact angle, mercury with a surface tension of 0.480 N/m, and correction for mercury compression applied, of more than 0.8 µm, and a pore size distribution, as measured by mercury intrusion porosimetry to a pressure of 2.1 x$10^8$ Pa using a Micromeretics Autopore 9200 model with 130° contact angle, mercury with a surface tension of 0.480 N/m, and correction for mercury compression applied, wherein at least 80 % of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 µm and at least 80 % of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 µm is contained in pores with diameters in the range of from 0.3 to 10 µm, and*
*b) depositing silver on the carrier*
*wherein the carrier comprises alumina and a bond material,*
*wherein the carrier has an α-alumina content of at least 95 weight percent, and wherein the bond material comprises an alkaline earth metal silicate bond material, and*
*wherein the catalyst comprises rhenium deposited on the carrier in addition to silver."*

Claim 1 of **auxiliary request 2** corresponds to that according to auxiliary request 1 with the additional feature: "*... wherein the carrier has a median pore diameter of at most 2.1 µm ...*"

The final requests of the parties were as follows:

The **appellant** requested that the decision be set aside and the patent be maintained on the basis of the claims according to the main request filed at the oral proceedings before the board on 7 March 2024 or, as an auxiliary measure, of one of auxiliary requests 1 or 2 also filed at the oral proceedings.

The **respondents** request that the appeal be dismissed.

## Reasons for the Decision

1. Main request - Inventive Step

The board has concluded that the requirements of Article 56 EPC are not met for the following reasons:

1.1 The alleged invention relates to an epoxidation catalyst and a process for its preparation based on the use of a carrier with a specific pore size distribution to ensure good long-term selectivity to the desired olefin oxides.

1.2 Closest prior art

1.2.1 Documents D1, D2, D4, D13, D14 or D15 have been cited as possible starting points. On the one hand, documents D1, D13 and D15 disclose epoxidation silver catalysts and discuss the use of various dopants to improve their catalytic performance. On the other hand, in D2 and

D14, which also disclose epoxidation silver catalysts, the aim is to improve the initial and long-term selectivity by adjusting the pore size distribution.

1.2.2 More specifically, D1 discloses on pages 18-23 epoxidation catalyst carriers J, O, S and T, which contain more than 95 wt.% α-alumina, have a median pore diameter of more than 0.8 µm and a pore size distribution falling within the scope of claim 1 at issue. The carriers are impregnated with silver to form catalysts (see e.g. claim 1), and the carriers have surface areas between 1.09 and 1.24 $m^2/g$, thus falling outside the claimed range. They however do not include rhenium or a bond material.

1.2.3 The appellant argued that D2 and D14 should be regarded as closest prior art, as these were the only documents addressing the same technical problem as the patent in suit. Document D1 should not be considered as such, because based on a different technical problem; furthermore no reference was made to the problem of maintaining high selectivity in the long term. Moreover, if D1 was selected as closest prior art, the skilled person would start from those embodiments providing the best results and would only consider the carriers with the pore size distribution according to the invention with the benefit of hindsight.

1.2.4 The board disagrees and observes that a document should only be disregarded as a starting point when its technical context is so far removed from that of the invention that a skilled person would only consider it with the benefit of hindsight. A document should however not be discarded as a starting point on the sole basis that it does not explicitly address the same subjective technical problem as the patent in suit.

1.2.5 D1 relates to epoxidation catalysts and aims at promoting the performance of α-alumina supported silver catalysts with specific pore size distributions. D1 is thus very close to the invention not only in terms of its technical features but also of the underlying technical context. The board thus concludes that there is no reason to disregard it as a starting point for the inventive step assessment.

1.2.6 The closest embodiments within D1 are those based on carriers having a pore size distribution falling within claim 1 at issue, i.e. carriers J, S, O or T. In this respect, the board notes that, contrary to appellant's arguments, any embodiment which is clearly and unambiguously disclosed can be used as a starting point, unless it is presented as a clearly undesirable or non-working alternative. Selecting the closest embodiments within the prior art is not the result of hindsight but follows directly from the standard application of the problem-solution approach, which requires using the most promising springboard as the starting point, precisely in order to assess whether or not the claims involve an inventive step in view of any disclosure made available to the public before the filing/priority date.

1.2.7 The subject-matter of claim 1 at issue differs from the above cited embodiments in D1 in that:

i) the surface area is 1,5 to 2,0 $m^2/g$,

ii) the carrier includes a bond material comprising an alkaline earth metal silicate, and

iii) the catalyst comprises rhenium.

1.3 Problem solved by the invention

1.3.1 According to the patent (par. [0006]), the alleged invention addresses the problem of improving the catalytic performance, in particular in terms of the long-term selectivity.

In the experimental section (paras. [0072] to [0096]), the patent compares the selectivity of catalysts with different pore size distributions in an initial stage and after some use. According to table III (page 12), the selectivity of the catalysts with a carrier having a pore size distribution according to the invention (catalysts A, B and C) is shown to be better at all stages than that of those with a different pore size distribution (catalysts D and E).

1.3.2 The appellant emphasised that the key object of the invention was not only to achieve a high selectivity but also to maintain it for a long time. Appendixes 2 to 5 were intended to further illustrate these technical effects. In particular, appendixes 3 and 4 demonstrated that the catalysts according to the invention led to higher selectivities, and appendix 5 illustrated why a person skilled in the art would not arrive at the claimed invention in an obvious way when starting from the catalysts in D1.

1.3.3 The board notes that no evidence has been provided that the proposed solution (i.e. the differentiating features) would successfully achieve the above cited effects of increasing the selectivity and/or the long-term selectivity. There is in particular no comparison between catalysts having a surface area within and outside the claimed range, catalysts with and without a bond material as defined in the claims, or catalysts with and without rhenium.

Instead, the tests in the patent and the appendixes focus on the effects of the pore size distribution by comparing catalysts with pore sizes falling within and outside the scope of the invention. This is however not illustrative of the effect with respect to document D1, as the carriers in this document already anticipate the pore size distribution proposed in the invention.

The only data which could have been used to demonstrate a technical effect in relation to the distinguishing features is found in Table 13 of Annex 4, where a comparison is made between between bonding materials comprising $Na_2O/SiO_2$ and talc ($MgSiO_3$). However, the only effect that can be deduced from these data is that the catalyst not according to the invention (using $Na_2O/SiO_2$ as bond material) performs better than that according to the invention (including $MgSiO_3$, an alkaline earth metal silicate bond material).

Furthermore, the results in the patent (see tables I and III) indicate that the selectivity tends to increase with decreasing surface area, which means that the catalysts according to the invention would actually perform worse in terms of this parameter (i.e. the one intended to be increased according to the invention) than those in the closest prior art D1 (which have lower surface areas). No further data could be identified that would demonstrate that the differentiating features with respect to D1 would indeed lead to an improvement of the selectivity and/or the long-term selectivity of the catalyst.

1.3.4 In view of the above considerations, the invention cannot be regarded as solving the problem of improving the initial and/or long-term selectivity of the catalyst in relation to the closest prior art, and so the problem must be reformulated less ambitiously in terms of <u>providing an alternative catalyst</u>.

1.4 Obviousness of the solution

1.4.1 D1 teaches (page 11, line 2) that the preferred surface area of the α-alumina carriers is 0.1 to 2 $m^2/g$, which overlaps with the range (1.5 to 2 $m^2/g$) in claim 1 at issue. D1 also discloses (page 7, lines 43-44) that in a preferred aspect the catalyst contains rhenium and that the carriers are made of α-alumina particles with a high purity of at least 98 wt-.%, and which are "often bonded together with a bonding material" (see D1, page 10, line 44).

1.4.2 The appellant put forward various arguments as to why it would not be obvious to a skilled person to incorporate the missing features in the relevant embodiments of D1. For the sake of clarity, the board will address the arguments presented for each of the differentiating features separately.

1.4.3 As regards the claimed "*surface area of 1.5 to 2* $m^2/g$", the appellant argued that a skilled person would not consider increasing the surface area of the carriers in D1 because there would be technical prejudices to do so. In particular, it was apparent from the information in table I on page 11 of D1 that the typical high purity α-alumina carriers had a surface area significantly lower than 1 $m^2/g$ and that all the exemplary embodiments in that document had a surface area lower than 1.5 $m^2/g$. In general, the teachings in the technical field indicated that large surface areas adversely affected the catalytic performance due to limitations of diffusion in the resulting smaller pores, thereby reducing catalyst selectivity.

1.4.4 The board notes that the question of whether or not a given teaching would be taken into account ultimately depends on the problem solved by the invention. Since in the present case the only problem solved is that of proposing an alternative, it is apparent that a skilled reader would contemplate catalysts falling within the claimed range of 1.5 to 2 $m^2/g$ by simply following the explicit teachings in D1. In particular, the fact that D1 refers to specific surface areas of 0.1 to 2.0 $m^2/g$, and that this is considered to be the most preferred range, suffices to conclude that a skilled person reading D1 would have no prejudice to contemplate carriers having a surface area as proposed in claim 1 at issue. The board is also not convinced of the alleged disincentives to contemplate higher surface areas on the basis that these would be detrimental for the selectivity. A skilled person is namely aware that increasing the surface area might increase the productivity at the expense of reducing the selectivity of the catalyst. The patent does not offer any surprising effect in this respect, as it is clear in view of the results in tables I and III that the selectivity of the catalysts according to the invention also worsens as the surface area increases. It therefore appears that both in the patent in suit and in D1 the option to work with higher or lower surface areas would be a matter of choice based on balancing the above mentioned opposing effects on a case-by-case basis.

1.4.5 As regards the claimed feature that the "*carrier includes a bond material comprising an alkaline earth metal silicate*", in the written proceedings, the appellant argued that claim 1 at issue and D1 concerned different types of carriers, with the former being a silicate-bonded $\alpha$-alumina carrier and the latter a high purity fluorine mineralised α-alumina carrier (from now on "FMA carrier"). Both the structure and the chemical properties of FMA carriers were very different from those of silicate bonded carriers. In particular, the fluoride was added to obtain a platelet-like structure and to remove impurities in order to reach high concentrations of α-alumina. The α-alumina purity was often so high that the remaining substances in the carrier could not be provided in a sufficient amount to act as bonding agents. Moreover, in view of the different properties and operating conditions, FMA carriers were generally not compatible with carriers using a bond material. The skilled person would thus have no incentive to combine the FMA carriers in D1 with a bonding material as proposed in the invention. The appellant filed appendix 5 to demonstrate the difficulties to reproduce the HFA catalysts of D13 (similar to those in D1) with the information in this document, and reported that the results obtained in terms of selectivity were rather poor and became even worse after adding a magnesium silicate bonding agent.

1.4.6 The board notes that appellant's arguments are based on the assumption that D1 is restricted to FMA carriers and that such carriers would be incompatible with a bonding material. This is however contradicted by the teachings in D1 (page 10, lines 44-45), which explicitly indicate that the preferred carriers are α-alumina particles often bonded together with a bonding agent. This disclosure can only be interpreted in two ways: either as an indication that the carriers in D1 could indeed include a bonding agent, i.e. that there is no incompatibility between the fluoride in the exemplary carriers and the bonding agent, or else as an indication that D1 contemplates both FMA carriers and carriers with a bonding material as alternatives.

Either way, the board concludes that when starting from D1, it would be obvious in view of the above cited teachings in this document to contemplate carriers including a bonding agent.

1.4.7 Document D1 does not disclose a specific bonding agent, which raises the question of whether the selection of *an alkaline earth metal silicate* as a bonding material (as defined in claim 1 at issue) would be an obvious consideration to a person skilled in the art.

The board first notes that according to appendix 4, the selectivity and the activity of a catalyst including magnesium silicate (i.e. talc) as bonding material are inferior to those obtained with a catalyst using $Na_2O$/$SiO_2$ as bonding agent (see "COMP2" vs. "INV1" in tables 13 and 14 of appendix 4). Thus the selected binder appears to be inferior to other known materials, so that the use of alkaline earth metal silicates can at best be considered as a mere alternative with no specific technical effect. Since the use of alkaline earth metal silicates as bonding material is not only known in the art but also associated with positive effects (see col. 5, lines 10-21 of D17), the board concludes that the selection of this material as bonding agent would represent an obvious choice among known alternatives.

1.4.8 As to the claimed feature that the catalyst "*comprises rhenium deposited on the carrier*", the appellant argued that the only embodiments in D1 including rhenium (see table III) were those using carrier N, which did not have a pore size distribution according to the invention. Moreover, D1 taught that the use of manganese was an essential part of the invention therein, so that the skilled person would have no incentive to incorporate rhenium. Consequently, a skilled person would only arrive at the claimed invention by arbitrarily combining isolated aspects of different embodiments in D1.

1.4.9 The board does not agree with this argumentation, because D1 explicitly teaches (page 7, lines 43-44) that the presence of rhenium is a preferred aspect of the invention. It is therefore obvious, particularly in view of the fact that the only problem solved is to provide an alternative catalyst, that the skilled person would consider alternative catalysts including the relevant carriers and rhenium without exercising inventive skill.

1.4.10 As to the combination of surface area with a carrier having the pore size distribution of the invention, the appellant argued that by modifying the surface area the skilled person would also affect the pore size distribution, i.e. higher surface areas would generally result in a higher proportion of small pores. As shown in Appendix 2, the pore size distribution could vary significantly for a given surface area. It was also unrealistic to expect that the skilled person would independently modify some aspects of the exemplary carriers without also affecting other characteristics. Therefore the conclusion that a skilled person would modify the carriers in D1 to satisfy both the pore size distribution and the surface area could only be reached with the benefit of hindsight. The appellant also emphasised that while a skilled person could arrive at the subject-matter by combining different elements from the prior art documents, such combination would only be considered when there was a certain expectation of an improvement.

1.4.11 The board first notes that the combination of different disclosures of the prior art does normally not entail (as the appellant appears to assume) reproducing the carriers described in the closest prior art to then modify their characteristics. Instead, the idea behind the problem-solution approach is to start with the technical teaching (not the physical entity) considered to be the closest prior art, and to assess whether the skilled person would contemplate solving the underlying technical problem by modifying the technical teachings in the closest prior art in ways which lead to the claimed invention. Therefore, once a combination of technical features is considered as an obvious solution for the underlying technical problem, this would be implemented by building a carrier reproducing all the desired features in combination. It is not contested that there are situations in which modifying a characteristic would inevitably affect other features: for example if the closest prior art is a composition with components adding up to 100%, changing the percentage of one component would inevitably affect the percentage of other components. In some cases it could also be argued that the skilled person would be unable to individually adjust some of the technical features without also affecting other features or confronting an undue burden. However, in the present case, the pore size distribution and the surface area are well known parameters commonly used to characterise catalytic materials. These features are standardly controlled and adjusted in the field of catalysts, so there is no reason to conclude that the skilled person would have any difficulty in independently adjusting them to the desired values.

In D1 the cited carriers are presented as exemplary embodiments and described in terms of their pore size distribution, which already indicates that this is an important parameter. A skilled person starting from D1 would therefore have no reason to deviate from the clear technical teaching in this document to select materials with pore size distributions having a higher proportion of small pores, as proposed in claim 1 at issue. As already concluded above, adjusting the surface area to values falling within the claimed range would also represent an obvious consideration.

The board further notes that it is not necessary for the skilled person to have an expectation of improvement in order to consider combining the above features. In this respect, the criteria for deciding whether or not a skilled person would consider a particular combination of features ultimately depend on the problem solved by the invention. If an invention does provide a specific improvement or effect, the burden is high and a combination should normally only be considered if a skilled person would recognise that such an effect or improvement would be obtained. However, where no improvement or effect is identified and the only problem solved is that of providing an alternative (as in the present main request), it is generally sufficient to show that the differentiating features are known alternatives to the features disclosed in the closest prior art, and that the skilled person would not be prejudiced in considering such alternatives.

1.5 In view of the above considerations, the board concludes that the subject-matter of claim 1 of the main request is obvious from the known prior art and thus does not involve an inventive step in view of the combined teachings of D1 and D17.

2. Auxiliary request 1 - Inventive Step

2.1 Claim 1 of this request further specifies the equipment used to measure the median pore size and the pore size distribution of the carrier.

2.2 The amendments, which appear to be aimed at avoiding or overcoming clarity objections, do not affect the inventive step argumentation against the main request, as there is no reason to conclude that the equipment used to measure the median pore size and the pore size distribution would provide any inventive contribution.

2.3 The same arguments and conclusions presented for the main request therefore apply to claim 1 of this request, which is thus not considered to involve an inventive step in view of the combined teachings of D1 and D17.

3. Auxiliary request 2 - Inventive Step

3.1 Claim 1 of this request further specifies that the median pore diameter is at most 2.1 µm.

3.2 The median pore diameter of the exemplary carriers J, S and T in D1 is respectively 1.85 µm, 1.7 µm, and 2.1 µm, so they all fall within the scope of claim 1.

3.3 Therefore the claimed invention is still considered to be obvious when starting from any of the above cited carriers in D1. Otherwise, the same arguments and conclusions presented for the main request apply to claim 1 of this request, which is thus not considered to be inventive in view of the combined teachings of D1 and D17.

4. It follows from the above conclusions that neither the content of appendixes 1 to 5 nor the allegedly new lines of defence of the appellant have affected the outcome of these proceedings, and that the late filed documents D27 to D32 are also not relevant to this decision. There is thus no need to decide on the admittance of the late filed arguments and evidence.

5. Since none of the requests filed by the appellant is considered to meet the requirements of the EPC, the appeal must be dismissed.

## Order

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar: The Chairman:

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

D. Hampe J.-M. Schwaller

Decision electronically authenticated