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**D E C I S I O N**  
**of 22 March 2005**

**Case Number:** T 0108/99 - 3.3.07

**Application Number:** 92101030.2

**Publication Number:** 0496386

**IPC:** B01J 21/14

**Language of the proceedings:** EN

**Title of invention:**

Catalyst carrier, composition and process for making same

**Patentee:**

NORTON COMPANY

**Opponent:**

CeramTec AG Innovative Ceramic Engineering

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 54, 56

**Keyword:**

"Novelty (yes)"

"Inventive step - (yes) after amendment - state of the art"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0108/99 - 3.3.07

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.07  
of 22 March 2005

**Appellant:** NORTON COMPANY  
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**Respondent:** CeramTec AG  
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**Representative:** Uppena, Franz, Dr.  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 19 November 1998  
revoking European patent No. 0496386 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** R. E. Teschemacher  
**Members:** B. L. ter Laan  
P. A. Gryczka

## Summary of Facts and Submissions

I. Mention of the grant of European patent No. 0 496 386 in respect of European patent application No. 92 101 030.2, filed on 22 January 1992, claiming priority from an earlier application in the USA (US 643604 of 22 January 1991), was published on 8 November 1995. The patent was granted on the basis of 22 claims, the independent claims reading:

"1. A catalyst carrier based on alpha alumina comprising at least about 85% by weight of alpha alumina, from 0.05 to about 6% by weight (measured as the oxide) of calcium or magnesium oxide; from 0.05 to about 5% by weight, (measured as silica) of a silicon oxide, and from zero to about 10% by weight (measured as the oxide) of a zirconium oxide."

"7. A carrier composition for preparing catalyst carriers according to one of the preceding claims, said composition comprising at least 85% by weight of alpha alumina, from 0.05 to about 6% by weight (measured as the oxide, MO,) of a calcium or magnesium oxide, from 0.05 to about 5% by weight (measured as silica) of a silicon oxide, and from zero to about 10% by weight (measured as the dioxide) of zirconium in the form of an oxide."

"8. A carrier composition for preparing catalyst carriers comprising at least 85% by weight of alpha alumina, from 0.05 to about 6% by weight (measured as the oxide, MO,) of a calcium or magnesium oxide, from 0.05 to about 5% by weight (measured as silica) of a silicon oxide, and from zero to about 10% by weight

(measured as the dioxide) of zirconium in the form of an oxide."

"15. A process for preparing a carrier for use as a catalyst carrier which comprises:

(a) mixing:

- (i) an alpha alumina powder having a purity of greater than about 98 percent and having an average crystallite size between 0.1 and 5 $\mu$ m,
- (ii) calcium or magnesium oxide or compound which is decomposable to or forms oxide upon calcination,
- (iii) a silicon oxide or compound which is decomposable to or forms an oxide upon calcination and
- (iv) optionally a zirconium oxide or compound which is decomposable to or forms an oxide upon calcination,

with water and a binder/burnout agent in amounts sufficient to provide in the finished carrier alpha alumina in an amount greater than about 85 percent by weight, a calcium or magnesium oxide in an amount ranging from 0.05 to 6% by weight, silicon oxide in an amount ranging from 0.05 to 5% by weight, and zirconium oxide in an amount ranging from zero to 10% by weight;

- (b) extruding the resulting mixture of step (a) to form pellets; and
- (c) calcining the pellets at a temperature greater than 1300°C for a time sufficient to produce a carrier having a surface ranging from 0.3 to 2 square meters per gram and a water pore volume ranging from 0.2 to 0.6 cubic centimeters per gram."

"20. A process for preparing a carrier for use as a catalyst carrier which comprises:

(a) mixing high purity alpha alumina powder, a calcium or magnesium oxide - providing compound, a silica providing compound and, optionally, a zirconia providing compound with water and a binder/burnout agent, in amounts sufficient to provide in the finished carrier alpha alumina in an amount greater than about 95 percent by weight, calcium silicate in an amount ranging from 0.05 to about 4 percent by weight, and zirconium oxide in an amount ranging from 0.3 to about 5 percent by weight;

(b) extruding the resulting mixture of step (a) to form pellets; and

(c) calcining the pellets at a temperature greater than 1300°C for a time sufficient to produce a carrier having a surface ranging from 0.3 to 2 square meters per gram and a water pore volume ranging from 0.2 to 0.6 cubic centimeters per gram."

II. A notice of opposition against the granted patent was filed on 18 July 1996, in which the revocation of the patent in its entirety was requested on the grounds of lack of novelty and inventive step as well as insufficient disclosure, as set out in Articles 100(a) and 100(b) EPC.

The opposition was, *inter alia*, supported by documents

D2 EP-B-0 076 504

D3 CH-A-677 110

D4 EP-A-0 266 015

III. In a decision issued in writing on 19 November 1998, the Opposition Division revoked the patent for lack of an inventive step. That decision was based on a set of 6 claims filed during the oral proceedings as the main request, and five auxiliary requests filed on 2 October 1998. The independent claims of the main request read:

"1. A catalyst carrier based on alpha alumina comprising at least about 85% by weight of alpha alumina, from 0.05 to about 6% by weight (measured as the oxide) of calcium or magnesium oxide; from 0.05 to about 5% by weight, (measured as silica) of a silicon oxide, and from 0.3 to 5% by weight (measured as the oxide) of a zirconium oxide, wherein the calcium or the magnesium and the silicon containing compounds in the carrier are present in the form of a single alkaline earth metal silicate which was added as an original component."

"2. A catalyst carrier based on alpha alumina comprising at least about 85% by weight of alpha alumina, from 0.05 to about 6% by weight (measured as the oxide) of calcium or magnesium oxide; from 0.05 to about 5% by weight (measured as silica) of a silicon oxide, and from 0.3 to about 5% by weight (measured as the oxide) of a zirconium oxide, comprising a single alkaline earth metal silicate prepared in situ by the reaction of silica or silica generating compounds with compounds that decompose to calcium or magnesium oxide upon heating, with the amount of the oxide formed being in stoichiometric excess over the silica so as to leave no residual base-soluble silica from this reaction."

"3. A composition for preparing a catalyst carrier comprising at least 85% by weight of alpha alumina powder, from 0.05 to about 6% by weight (measured as the oxide, MO,) of a calcium or magnesium oxide, from 0.05 to about 5% by weight (measured as silica) of a silicon oxide, and from 0.3 to about 5% by weight (measured as the dioxide) of zirconium in the form of an oxide, wherein the calcium or the magnesium and the silicon containing compounds are in the form of a single alkaline earth metal silicate, or silica or silica generating compounds and compounds that decompose to calcium or magnesium oxide upon heating, forming a single alkaline earth metal silicate by the reaction of said oxides with silica, the compounds that decompose to calcium or magnesium oxide upon heating being present in such amounts that the amount of the oxide formed is in stoichiometric excess over the silica, a binding agent and a burn-out agent."

"6. A process for preparing a catalyst carrier comprising the following steps:

(a) mixing:

- (i) an alpha alumina powder having a purity of greater than about 98 percent and having an average crystallite size between 0.1 and 5  $\mu\text{m}$ ,
- (ii) calcium or magnesium compound which is decomposable to or forms oxide upon calcination,
- (iii) a silicon oxide or compound which is decomposable to or forms an oxide upon calcination and

- (iv) a zirconium oxide or compound which is decomposable to or forms an oxide upon calcination,  
with water and a binder/burnout agent in amounts sufficient to provide in the finished carrier alpha alumina in an amount greater than about 85 percent by weight, a calcium or magnesium oxide in an amount ranging from 0.05 to 6% by weight, silicon oxide in an amount ranging from 0.05 to 5% by weight, and zirconium oxide in an amount ranging from 0.3 to 5% by weight,
- (b) extruding the resulting mixture of step (a) to form pellets; and
- (c) calcining the pellets at a temperature greater than 1300°C for a time sufficient to produce a carrier having a surface area ranging from 0.3 to 2 square meters per gram and a water pore volume ranging from 0.2 to 0.6 cubic centimeters per gram and to achieve a single alkaline earth metal silicate by the reaction of the compounds (ii) and (iii) wherein in step (a) compound (ii) is added in such an amount the amount of the oxide formed is in stoichiometric excess over the silica so as to leave no residual base-soluble silica."

In the decision under appeal the following was held:

- (a) In view of the amendments resulting from the discussion in the oral proceedings, the claims were clear (Article 84 EPC).
- (b) Regarding sufficiency of disclosure, although the measuring method had not been indicated, the skilled person would be able to determine the size



of the alpha alumina particles. The absence of base-soluble silica was achieved by the use of either a single alkaline earth metal which remained unchanged during calcination, or by the use of oxide-providing compounds. Therefore, Article 83 EPC was complied with.

- (c) As to novelty, none of the cited documents disclosed all the claimed features, in particular they did not mention the use of an alkaline earth metal silicate or the use of a mixture of silica and calcium or magnesium compounds which provided oxides upon calcination, in the absence of base-soluble silica due to the stoichiometric ratios used. Therefore, the claimed subject-matter was novel (Article 54 EPC).
- (d) The problem to be solved was to provide a catalyst carrier particularly suited for preparing an ethylene oxide catalyst with high initial selectivity and high stability. However, that problem was not shown to be solved by the claimed subject-matter. The improvement in the daily increase of the temperature could not be taken into account as the complete experimental data were not available. Therefore, no inventive step could be recognised (Article 56 EPC).
- (e) In view of the amendments to the main request which was derived from one of the auxiliary requests, only one auxiliary request remained to be examined. For that request, the same arguments were valid as for the main request, so that the auxiliary request was also not inventive.

IV. On 27 January 1999, the Proprietor (Appellant) lodged an appeal against the above decision and paid the prescribed fee simultaneously. The statement setting out the grounds of appeal was filed on 29 March 1999. It contained two declarations by Mr Gerdes as well as a set of six claims as the main request.

With a letter dated 3 June 2002, the Appellant filed additional experimental data as well as three sets of claims as the new main and two auxiliary requests, which were replaced by three sets of claims as the new main and two auxiliary requests filed with letter of 1 March 2005, together with amended pages of the patent specification.

V. By letter of 21 May 2003, the respondent filed a new document (US-A-4 171 288, hereinafter D5). Two further documents (US-A-5 145 824 and its equivalent EP-A-0 496 470, hereinafter D6) were referred to in a letter dated 1 March 2005. The latter documents had the same priority date as the patent in suit.

VI. Oral proceedings before the Board were held on 22 March 2005. During the oral proceedings, after discussion of the allowability of the amendments in the main request under Articles 123(2) and 123(3) EPC, the Appellant filed a new main request, the independent claims reading as follows:

"1. A catalyst carrier based on alpha alumina comprising at least 85% by weight of alpha alumina, from 0.05 to 6% by weight (measured as the oxide) of calcium or magnesium oxide; from 0.05 to 5% by weight

(measured as silica) of a silicon oxide, and from 0.3 to 5% by weight (measured as the oxide) of a zirconium oxide, wherein the calcium or magnesium and silicon containing compounds in the carrier are in the form of a single alkaline earth metal silicate which was added as an original component."

"2. A catalyst carrier based on alpha alumina comprising at least 85% by weight of alpha alumina, from 0.05 to 6% by weight (measured as the oxide) of calcium or magnesium oxide; from 0.05 to 5% by weight (measured as silica) of a silicon oxide, and from 0.3 to 5% by weight (measured as the oxide) of a zirconium oxide, comprising an alkaline earth metal silicate prepared in situ by the reaction of silica or silica generating compounds with compounds that decompose to calcium or magnesium oxide upon heating, with the amount of the oxide formed being in stoichiometric excess over the silica, so as to leave essentially no residual base-soluble silica."

"3. A carrier composition for preparing a catalyst carrier comprising at least 85% by weight of alpha alumina powder, from 0.05 to 6% by weight (measured as the oxide, MO) of a calcium or magnesium oxide, from 0.05 to 5% by weight (measured as silica) of a silicon oxide, and from 0.3 to 5% by weight (measured as the dioxide) of zirconium in the form of an oxide, a binding agent and a burnout agent, wherein the calcium or magnesium and the silicon containing compounds are in the form of a single alkaline earth metal silicate."

"4. A carrier composition for preparing a catalyst carrier comprising at least 85% by weight of alpha

alumina powder, from 0.05 to 6% by weight (measured as the oxide, MO) of calcium or magnesium compounds that decompose to calcium or magnesium oxide upon heating, from 0.05 to 5% by weight (measured as silica) of silica or silica generating compounds, and from 0.3 to 5% by weight (measured as the dioxide) of zirconium in the form of an oxide, a binding agent and a burnout agent, wherein the calcium or magnesium oxide by the reaction with silica forms an alkaline earth metal silicate, and wherein said compounds that decompose to calcium or magnesium oxide upon heating are present in such amounts that the amount of the oxide formed is in stoichiometric excess over the silica, so as to leave essentially no residual base-soluble silica."

"7. A process for preparing a catalyst carrier comprising the following steps:

(a) mixing:

- (i) an alpha alumina powder having a purity of greater than 98 percent and having an average crystallite size between 0.1 and 5  $\mu\text{m}$ ,
- (ii) a calcium or magnesium compound which is decomposable to or forms oxide upon calcination,
- (iii) a silicon oxide or compound which is decomposable to or forms an oxide upon calcination and
- (iv) a zirconium oxide or compound which is decomposable to or forms an oxide upon calcination,

with water and a binder/burnout agent in amounts sufficient to provide in the finished carrier alpha alumina in an amount greater than 85 percent

by weight, a calcium or magnesium oxide in an amount ranging from 0.05 to 6% by weight, silicon oxide in an amount ranging from 0.05 to 5% by weight, and zirconium oxide in an amount ranging from 0.3 to 5% by weight,

- (b) extruding the resulting mixture of step (a) to form pellets; and
- (c) calcining the pellets at a temperature greater than 1300°C for a time sufficient to produce a carrier having a surface area ranging from 0.3 to 2 square meters per gram and a water pore volume ranging from 0.2 to 0.6 cubic centimeters per gram and to generate in situ an alkaline earth metal silicate by the reaction of the compounds (ii) and (iii) wherein in step (a) compound (ii) is added in such an amount that the amount of the oxide formed is in stoichiometric excess over the silica, so as to leave essentially no residual base-soluble silica."

VII. The Appellant's arguments given in writing and during the oral proceedings can be summarised as follows:

- (a) The new claims fulfilled the requirements of Articles 123(2) and (3) EPC. The restrictions regarding the carrier material as now defined in the claims excluded the presence of alumina in the silicate, so that examples H and N of the patent specification were no longer within the scope of the claimed subject-matter.

- (b) The range for the content of SiO<sub>2</sub> specified in the claims had been disclosed in the priority document so that the priority claim was valid. Therefore, D6, which had the same priority date as the patent in suit, could not be cited against the novelty of the claimed subject-matter.

The composition disclosed in D3 was, in view of its density and its lack of ability to absorb water, not suitable for use as a catalyst carrier. In example 8, the composition contained chromium oxide, which was known as a catalyst poison. Also, there was no burnout agent present. Therefore, D3 did not disclose the claimed carriers, nor the compositions for preparing them. As a result, the claimed subject-matter was novel.

- (c) The carrier compositions described in D2 were closer in their composition to the claimed carriers than those of D4. Since the patent in suit concerned the properties of the carrier rather than those of the catalyst itself, D2 was the closest document for the assessment of an inventive step.
- (d) The problem to be solved over D2 was to provide a catalyst carrier that improved the properties of the catalyst, in particular in terms of a longer life. A comparison of example 1 of D2, which contained excess silica, with carrier L of the patent in suit showed the negative effect of the presence of base-soluble silica, so that it could be concluded that the improvement in catalyst

properties, due to the carrier properties, had effectively been achieved.

- (e) Since the claimed carrier compositions and methods to prepare them were not hinted at in the cited documents, the presence of an inventive step could not be denied.

VIII. The Respondent's arguments given in writing and during the oral proceedings can be summarised as follows:

- (a) No formal objections were raised having regard to the claims filed during the oral proceedings.
- (b) Since the range of 0.05 to 5 wt% SiO<sub>2</sub> given in the claims had not been disclosed in the priority document, the priority claim was not valid so that D6, which disclosed the claimed carriers, prejudiced the novelty of the claimed subject-matter.

D3 disclosed materials having the same composition as that required by claims 1 to 4; they could be used as a catalyst carrier. D3 also described the proportions of the various metals, so that the claimed subject-matter was not novel anymore.

- (c) Regarding inventive step, D4 was the closest prior art document since it disclosed the same type of catalyst as the patent in suit and a similar carrier. In particular, the catalysts of D4 had more technical features in common with the present catalysts than those of D2. The catalysts of D4 had the same or better properties, in particular

selectivity, so that the present catalyst did not show any improvement over D4. Even if the present compositions showed any effect, it would be due to the reaction conditions under which the catalysts were used rather than to the carrier upon which the catalyst had been deposited. Hence, the claimed subject-matter was not inventive.

IX. The Appellant (Proprietor) requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request as submitted during the oral proceedings or, alternatively, on the basis of one of the two auxiliary requests filed by letter of 1 March 2005.

The Respondent (Opponent) requested that the appeal be dismissed.

### **Reasons for the Decision**

1. The appeal is admissible

#### *Main request*

2. *Amendments*

The Respondent did not raise any formal objections against the claims as filed during the oral proceedings. In view of the disclosure in the original application in the claims and on page 2, lines 13 to 22; page 3, lines 21 to 26, and page 4, lines 16 to 18, the board sees no reason to take a different position. The



requirements of Articles 123(2) and (3) and 84 EPC are fulfilled.

3. *Novelty*

3.1 In the priority document the amounts of silicon oxide in the final carrier composition are indicated as "...from about 0.01 to about 5.0%, such as from about 0.03 to about 4.0% and most conveniently from about 0.05 to about 3.0% by weight, (measured as silica)." (claim 1; page 4, lines 11 to 15). Hence, both the lower limit of about 0.05 wt% and the higher limit of about 5.0 wt% are mentioned, albeit each in combination with another counterpart. However, according to established practice the combination of a lower limit of a preferred range with the higher limit of the broadest range, still including the most preferred range, does not imply a change of the invention (Case law of the Boards of Appeal of the EPO, 4th ed. 2001, III.A.3.3, p. 220 of the English version). Therefore, the priority right is validly claimed. As a consequence, neither D6 nor its US equivalent are prior art documents in the sense of Article 54(2) EPC.

3.2 D3 is a national Swiss patent that has been published on 15 April 1991, after the priority date of the patent in suit (2 January 1991). However, the underlying international application was published on 7 September 1988 (WO 88/06575), so that its contents were in the public domain before the priority date of the patent in suit. In view of that, and since both parties continued to base their arguments on D3 as if it were a prior art document in accordance with Article 54(2) EPC, the references below also refer to D3.

D3 discloses a process for the preparation of alumina ceramics having an increased abrasion resistance which comprises adding, before forming, to 96-99.5% by weight of aluminium oxide 0.1-4% by weight of a eutectic sintering additive prepared from 38.5-71.5% by weight of calcium fluoride and 28.5-61.5% by weight of magnesium fluoride by thermal treatment either per se and/or in a form applied onto a carrier, grinding the components, forming the mixture and sintering the shaped articles at a temperature above 1300°C (claim 1).

The ceramics are mainly used in the manufacture of cylinder liners for drilling slime and slurry pumps; and also in a wide range of other engineering applications (page 2, lines 7 to 12).

In example 8, a sintering additive containing calcium fluoride and magnesium fluoride in the form of at least 90%  $\text{CaF}_2 \cdot \text{MgF}_2$  (No. 1; page 5, lines 7 to 9), as well as chromium oxide, zirconium silicate and magnesium spinel are added to a calcinated aluminium hydrate and the mixture is ground. After drying and sintering, the product contained 98 wt% aluminium oxide, 1 wt% chromium oxide, 0.6 wt% zirconium silicate, 0.3 wt% magnesium oxide and at most 0.1 wt%  $\text{CaF}_2 \cdot \text{MgF}_2$ . It had a density of 3.87 g/cm<sup>3</sup> and a water absorption capacity of 0.

The reference to a catalyst carrier in the present claims implies a restriction to compositions or substances having properties that make them suitable for use as catalyst carriers, such as density, ability to absorb water and absence of substances that may act

as catalyst poisons. D3 does not relate to catalyst carriers. In example 8, the ceramic product has a water absorption capacity of 0, so that it would appear to be improbable that it could be impregnated with a solution containing catalyst compounds, such as is done in the patent in suit. Also, it is plausible that the density and the presence of  $\text{Cr}_2\text{O}_3$  render it unsuitable for use as a catalyst carrier. In fact, the respondent did not deny that the ceramic product of D3 was, in the form described in example 8, not suitable for use as a catalyst carrier. In addition, from the fields of application of the ceramics according to D3 described on page 2, lines 7 to 12, it is probable that the properties required for the products of D3 are different from those required for catalyst carriers.

Furthermore, the process for preparing the ceramic substance according to D3 differs from that specified in the present claims in that in D3 no single alkaline earth metal silicate is used either as such or in the form of decomposable compounds in a proportion so as to leave essentially no residual base-soluble silica. Also, no burnout agent is present.

In view of this, there are severe doubts that the compounds described in D3 have the same properties as those of the patent in suit, so that it has not been established that they are identical. Therefore, D3 does not prejudice the novelty of the subject matter now being claimed.

- 3.3 None of the other documents is more relevant to novelty than D3 and the respondent did not raise any objections on their basis. In particular, no novelty objections

were raised on the basis of D2 or D4. Since neither of those two documents mentions the use of a single alkaline earth metal silicate as such or in the form of decomposable compounds in a proportion so as to leave essentially no residual base-soluble silica, the board sees no reason to take a different position.

The claimed subject matter is therefore novel.

4. *Inventive step*

4.1 The patent in suit concerns a catalyst carrier, composition and process for making same. It aims at providing carriers for ethylene oxide catalysts with a high initial selectivity and a long life (enhanced stability) (page 4, lines 8 and 9). From the examples in the patent in suit and the experiments filed later in the proceedings, it can be seen that catalysts on carriers in accordance with the patent in suit have a good selectivity in combination with a high longevity. Therefore, it can be accepted that the catalyst is functional, which was not contested. The parties did however not agree on the question which of D2 or D4 was the closest prior art document and whether or not an improvement over either D2 or D4 had been achieved.

4.2 D2 concerns a silver catalyst and method for the manufacture of ethylene oxide. It describes a process for preparing a supported silver catalyst comprising:  
(a) impregnating a porous catalyst support with a solution comprising a solvent or a solubilizing agent and a silver salt;

- (b) heat treating the impregnated support to convert at least a fraction of the silver salt to silver metal and deposit silver on the surface of the support;
- (c) impregnating the support treated in step (b) with a solution containing an organic solvent and at least one metal cation promoter; and
- (d) heat treating the impregnated support produced in step (c) to deposit the promoter on the surface of the support characterized in that in step (c) a solution comprising equal or more than 28.45 percent, by volume, of an organic solvent capable of forming a complex with silver ion selected from a specified group of nitrogen containing solvents, and at least one compound of an alkali metal promoter is used (claim 1).

The carriers used in D2 may contain various compounds, of which alpha alumina is preferred as the base material, the remaining components being silica, alkali metal oxides (e.g. sodium oxide), alkaline earth oxides, iron oxide and other oxides (column 10, lines 14 to 29).

In example 1, column 12, the chemical composition of a carrier is specified as containing 98.6 wt% alpha-alumina, 0.74 wt% silicon oxide, 0.22 wt% calcium oxide, 0.16 wt% sodium oxide, 0.14 wt% ferric oxide, 0.03 wt% potassium oxide and 0.03 wt% magnesium oxide. After the deposition of the silver catalyst on the carrier, the carrier is impregnated with a solution containing the promoter (column 8, lines 58 to 61).

D2 aims at catalysts with improved efficiency and not needing a very strict control of the amount of promoter in order to achieve the optimum catalyst efficiency (column 6, lines 55 to 63). The improvement in catalyst

efficiency is attributable to the presence of nitrogen oxide (column 4, lines 55 to 60). In order to achieve its goal, D2 concentrates on the impregnation of the carrier with catalyst and promoter components rather than on the carrier itself and its preparation. In fact, in column 10, lines 14 to 15, it is stated that the chemical composition of the carrier is not narrowly critical. Accordingly, no details are given about the preparation of the carrier.

- 4.3 D4 concerns an ethylene oxide catalyst and process for the catalytic production of ethylene oxide. It discloses a composition containing silver, a support, rhenium and at least one further metal, characterized in that the selected amounts of the metals or compounds are such that under conditions of catalytic manufacture of ethylene oxide from ethylene and oxygen the composition comprises a catalytically effective amount of silver, a promoting amount of rhenium or compound thereof and a promoting amount of at least one further metal or compound thereof (claim 1).

The support or carrier employed for the catalysts of D4 is described on page 3, line 20 to page 5, line 16. Suitable materials are aluminum oxides, charcoal, pumice, magnesia, zirconia, kieselguhr, fullers' earth, silicon carbide, porous agglomerates comprising silica and/or silicon carbide, silica, magnesia, selected clays, artificial and natural zeolites and ceramics. The aluminous materials, in particular those comprising alpha alumina, are preferred (page 3, lines 25 to 30). In Table 1, page 4, the composition and properties of a number of carriers are given. They consist for the main part of alpha alumina (varying from 70 to 99.5 wt%) and

SiO<sub>2</sub> (30 to 0.5 wt%) and ppm amounts of water-leachable Na and K as well as acid-leachable Na and Fe. The presence of calcium or magnesium is not mentioned. Suitable manufacturers of carriers are indicated, but no details about the preparation of the carrier material are given.

In Example 10, page 4, referred to by the Respondent, a catalyst was prepared by impregnating a carrier similar to carrier B of Table 1 (page 4), with a solution comprising silver ions, cesium ions, rhenium-containing ions and sulfur containing ions.

The aim of D4 is to provide a catalyst with an optimum selectivity performance in combination with improved stability (longevity) (page 2, lines 19 to 25). Like D2, the emphasis of D4 lies on improving the catalyst by selecting the nature and amounts of catalytically active material and promoters to be deposited on the carrier, not by modifying or optimizing the carrier itself.

- 4.4 The closest state of the art is usually seen as the document having the same purpose or effect as the patent in suit and addressing the same or a similar problem (Case Law of the Boards of Appeal of the European Patent Office, *supra*, I.D.3.1 and 2). In that light, it appears that D4, which also mentions longevity as one of the desirable characteristics of a catalyst, is the closest document.

However, from the above analysis of D4 and D2 it appears that neither of those documents discloses the concept of modifying the catalyst carrier and to investigate the influence of the method of preparation

of the carrier on the catalyst properties. The patent in suit considers the composition of the carrier material before calcination, whereas in both D2 and D4 standard carriers are used and the emphasis of catalyst improvement lies on the substances used to prepare the impregnation solutions for the catalyst, deposited on the carrier material after its calcination.

Therefore, whichever of the two documents serves as the starting point and even if the problem to be solved were to be formulated as broadly as providing an alternative catalyst regardless of any improvement over the prior art, still neither of the documents, taken alone or together, hints in general at modifying the carrier instead of the catalyst, and in particular at preparing the carrier either from a single alkaline earth metal silicate as such or in the form of decomposable compounds so as to leave essentially no residual base-soluble silica.

- 4.5 D5, which was also cited by the Respondent during the oral proceedings, describes supports of heat-stabilized alumina resulting from calcination in the presence of minor amounts of e.g. ZrO<sub>2</sub>, TiO<sub>2</sub>, alkaline earth metal oxides such as calcium oxide, or rare earth oxides. D5 does not mention the ratios of the various components, nor their influence on the catalyst. Moreover, the support is used for hydrocarbon conversion catalysts, which is a different type of reaction requiring a different type of catalyst than the ethylene oxide preparation for which the catalysts of the patent in suit are intended. Therefore, D5 cannot serve to guide the skilled person in the direction of the claimed subject-matter either.



4.6 In view of the above, the board comes to the conclusion that the claimed subject-matter is inventive.

## **Order**

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

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of claims 1 to 7 as submitted during the oral proceedings as the main request and a description yet to be adapted.

The Registrar:

The Chairman:

C. Eickhoff

R. Teschemacher