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**Datasheet for the decision
of 17 January 2008**

Case Number: T 0956/04 - 3.3.07

Application Number: 95926949.9

Publication Number: 0775018

IPC: B01J 23/74

Language of the proceedings: EN

Title of invention:
Cobalt on alumina catalysts

Patentee:
Johnson Matthey PLC

Opponent:
Akzo Nobel N.V.

Headword:

-

Relevant legal provisions:
EPC Art. 84, 123(2),(3)

Relevant legal provisions (EPC 1973):
EPC Art. 84, 123(2),(3)

Keyword:
"Main and auxiliary requests 1, 3 to 5 - clarity of product-
by-process feature - no clearly distinguishable product
feature - not allowable"
"Auxiliary request 2 - amendment - not admissible"

Decisions cited:
T 0150/82, T 0552/91, T 0925/98

Catchword:

-



Case Number: T 0956/04 - 3.3.07

DECISION
of the Technical Board of Appeal 3.3.07
of 17 January 2008

Appellant:
(Patent Proprietor)

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Decision under appeal:

Interlocutory decision of the Opposition
Division of the European Patent Office posted
28 May 2004 concerning maintenance of European
patent No. 0775018 in amended form.

Composition of the Board:

Chairman: S. Perryman
Members: B. Struif
G. Santavicca

Summary of Facts and Submissions

- I. The appeal of the patentee (appellant) lies from the interlocutory decision posted 28 May 2004, in which the opposition division, at the oral proceedings held on 12 May 2004, had decided that the patent in amended form based on a set of claims 1 to 5 submitted as auxiliary request at the oral proceedings before the opposition division met the requirements of the EPC. Claims 1 to 5 of the auxiliary request corresponded to granted claims 7 to 11. The decision furthermore concerned a set of claims 1 to 11 as the main request which was refused.

Claim 1 of the main request had the following wording (amendments to the claims as granted are indicated in bold):

Main request:

"A catalyst, comprising cobalt on a support of transition alumina, having a cobalt content between 3 and 40% by weight, **and which, when reduced with hydrogen at 425°C, has** a cobalt metal surface area, as measured by hydrogen chemisorption **at 150°C**, above 40 m² per g of cobalt, **obtainable by a process comprising heating a mixture of transition alumina and an aqueous solution of cobalt ammine carbonate to a temperature of 60°C to 110°C in order to allow cobalt hydroxycarbonate to precipitate, drying and calcining the resulting product, the amounts of transition alumina and cobalt ammine carbonate employed being such that the calcined product has a cobalt content between 3 and 40% by weight.**"

Claim 1 of the auxiliary request corresponding to claim 7 as granted, was as follows:

"A process for manufacturing a catalyst comprising cobalt on a transition alumina support and having a cobalt surface area above 30 m²/g of cobalt, said process comprising heating a mixture of transition alumina and an aqueous solution of cobalt ammine carbonate to a temperature of 60°C to 110°C in order to allow cobalt hydroxycarbonate to precipitate, drying and calcining the resulting product at a temperature between 200 to 600°C, the amounts of transition alumina and cobalt ammine carbonate employed being such that the calcined product has a cobalt content between 3 and 40% by weight."

II. A notice of opposition had been filed against the granted patent, in which revocation of the patent in its entirety was requested on the grounds of Article 100(a) EPC (lack of novelty and lack of an inventive step) as well as on the ground of Article 100(c) EPC. The opposition was supported *inter alia* by the following documents:

D1: US-A-4 717 702

D2: GB-A-926 235

During the opposition proceedings further documents were cited, *inter alia* the following:

D4: Fu and C. H. Bartholomew, Journal of Catalysis, 92 (1985), pages 376 - 387

D5: US-A-4 605 679

D6: B. G. Johnson et al., Journal of Catalysis 128
(1991), pages 231-247

III. The opposition division held that:

- (a) As regards novelty, documents D1, D4, D5 and D6 all disclosed catalysts comprising cobalt on gamma alumina having a cobalt metal surface above 40 m²/g of cobalt as calculated from the measured hydrogen chemisorption after reducing with hydrogen at 350 or 400°C. The calculations were not contested. The product-by-process definition of the products of claim 1 according to the main request was only allowable if the products as such were novel and inventive. The only features of the claimed catalyst which could be compared with the prior art catalyst were the cobalt surface area, the amount of cobalt and the transition alumina support, which were the same. There was no evidence on file showing that the specific process steps provided a catalyst that was different from those of D1 and D4 to D6. Thus, the subject-matter of claim 1 of the main request was not novel.
- (b) As regards the amendments in claim 1 of the auxiliary request, the calcination temperature defined in claim 1 and the transition alumina being in the form of extrudates in claim 4 could be derived from the application as filed. Thus, Article 123(2) EPC was not violated so that the opposition ground under Article 100(c) EPC was not fulfilled.

(c) As regards inventive step of the subject-matter of the auxiliary request, the process described in D4 was considered to represent the closest state of the art. That process provided a cobalt surface area of 89 m²/g when the reduction had taken place at 400°C. The process of Claim 1 differed from that of D4 both in the use an aqueous solution of cobalt ammine carbonate (instead of using a cobalt carbonyl compound) and a precipitation method. No new technical effect in the properties of the catalysts arose from those different process steps, however. Thus, the problem over D4 was the provision of further cobalt on transition alumina catalysts with a high cobalt surface area.

In D4, high surface areas could be achieved only by the decomposition of cobalt carbonyl, whilst precipitation methods did not lead to the desired high cobalt surface areas. In D2, only nickel catalysts supported on silica obtained by using metal ammine carbonates were exemplified, but no values for the surface area were given. Although D2 also mentioned the preparation of cobalt catalysts, there was no indication either that by such a method high cobalt surface areas would be achieved. Consequently, the subject-matter of the auxiliary request involved an inventive step.

IV. On 28 July 2004, the patent proprietor (appellant) filed a notice of appeal against the above decision, the prescribed fee being paid on the same day. In their statement setting out the grounds of appeal filed on 28 September 2004, the appellant maintained the requests underlying the decision under appeal and

enclosed experimental evidence in the form of a test report and *inter alia* the following document:

D10: C. Martin Lok: "*Novel highly dispersed cobalt catalysts for improved Fischer-Tropsch productivity*", Elsevier B. V., 2004.

- V. In reply to a communication of the board, the appellant filed (by letter of 17 December 2007) four auxiliary requests whilst maintaining the claims underlying the decision under appeal. Furthermore, the appellant submitted additional experimental evidence to show the difference of the claimed subject-matter over that of the prior art documents.

Claim 1 of auxiliary request 1 differs from claim 1 of the main request in that the cobalt content has been specified to be from "10 to 40% by weight".

Claim 1 of auxiliary request 2 differs from claim 1 of the main request in that the cobalt content has been specified to be from "20 to 40% by weight".

Claim 1 of auxiliary request 3 differs from claim 1 of the main request in that the cobalt content has been specified to be from "10 to 20% by weight".

- VI. The respondent contested the experimental evidence submitted by the appellants (letter dated 7 February 2005).
- VII. On 17 January 2008, oral proceedings were held, at which the appellant submitted auxiliary requests 4 and 5.

Claim 1 of auxiliary request 4 corresponds to claim 1 of auxiliary request 1, except for the following features being added after the words "calcining the resulting product":

"at a temperature of from 200 - 600°C and activating the product with hydrogen gas at temperatures between 350 and 550°C".

Claim 1 of auxiliary request 5 differs from claim 1 of auxiliary request 4 in that the cobalt metal surface area has been specified to be "above 80 m² per g of cobalt".

VIII. The arguments of the appellant can be summarized as follows:

- (a) As regards the amendments made to all requests, in particular, the calcination step in claim 1 of the main request without indication of the specific temperature, they had a basis in the application as filed. Furthermore, the product-by-process feature, following the expression "obtainable by" (hereinafter the "obtainable-by" features), had a basis in the application as filed and resulted in a restriction of the protection conferred by the granted product claim. Thus, the amendments met the requirements of Article 123, paragraphs (2) and (3), EPC.
- (b) As to clarity of the "obtainable by" features, D4 disclosed three methods for preparing catalysts comprising cobalt metal on an alumina support as

follows: impregnation of a support with an aqueous solution of cobalt nitrate, pH controlled precipitation, and decomposition of cobalt carbonyl on dehydroxylated alumina. These different preparation methods produced different catalyst structures providing different selectivities in the Fischer-Tropsch reaction. Since, cobalt carbonyl decomposition provided the highest cobalt metal surface area, the cobalt carbonyl decomposition according to D5 and D6 as well as the nitrate impregnation were repeated in the test reports. The "obtainable-by" features of claim 1 included an aqueous solution of cobalt ammine carbonate, which necessarily had a high pH value. A further specification of the alumina support material was not necessary, as illustrated by a test report.

The "obtainable-by" features produced a different cobalt microstructure, i.e. a clear distinction of the product claim. D10 and the evidence on file showed that the process feature provided crystallite sizes of 3-5 nm having a narrower and more uniform crystallite size distribution than the prior art catalysts so that a more stable catalyst was provided. There was a direct correlation between the "obtainable-by" features with the catalyst crystallite structure providing a higher cobalt metal surface area for each cobalt content than prior art catalysts. There was no prior art process described in the documents on file, by which the more uniform distribution of cobalt crystallite structure could be achieved. The respondent had not shown the contrary. Thus,

the product-by-process features were clear pursuant to Article 84 EPC.

- (c) In claim 1 of auxiliary request 4 and 5 the process features were more clearly defined by reference to the calcination and the hydrogenation temperature so that the skilled person had less choice how to produce the claimed catalyst. In addition, the cobalt metal surface area had been specified to be above 80 m² per g cobalt in auxiliary request 5. These features included a clear restriction and provided a different crystalline structure over the prior art catalysts.

IX. The arguments of the respondent can be summarized as follows:

- (a) Since the calcination temperature of granted claim 7 was not introduced in the "obtainable-by" features of the product claim, the scope of protection of the product claims was extended.
- (b) In general, product-by-process features were only allowable if the product itself was novel and inventive. In that respect, the skilled person must be able to clearly recognize what product feature made the difference over the prior art. The particular "obtainable-by" feature as claimed should not be allowed, because the appellant could restrict his claims by direct product features. Since it was not clear which product feature distinguished the catalyst from the prior art, the product-by-process feature introduced uncertainty

for the public when establishing the scope of the claim.

All of the catalysts according to D1 and D4 to D6 possessed a higher cobalt metal surface area than that required by claim 1 of the main request and claim 1 of any of the auxiliary requests. The test reports of the appellant only showed that the prior art methods led to catalysts having a cobalt content of 3 to 40% and a cobalt surface area above 40 m²/g of Co and thus meeting the requirements of the claimed subject-matter. Furthermore, in the test reports, the prior art examples had not been properly reworked, since all the experiments used the same type of alumina support material whilst D1, D4, D5 and D6 used different alumina supports in their examples. The type of support, the pore volume thereof and its pretreatment considerably influenced the cobalt metal surface area. Furthermore, the reworked samples according to D5 did not achieve the cobalt metal surface area reported in D5. It was not clear what the term "uniform" crystallite size distribution meant. The argued different crystallite structure was not mentioned in the application as filed and was not the direct result of the claimed "obtainable-by" features.

- (c) The additional process features mentioned in claim 1 of auxiliary requests 4 and 5 did not provide a clear, distinguishing product feature over the prior art, because the catalysts of D5 and D6 already showed a very high cobalt metal surface area.

X. The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request underlying the decision under appeal, or on the basis of auxiliary requests 1, 2 or 3 submitted by letter dated the 17 December 2007, or on the basis of auxiliary requests 4 or 5 submitted at the oral proceedings on 17 January 2008.

XI. The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Main request

Amendments

2. In claim 1, the cobalt metal surface area of the catalyst has been specified by indicating the reduction with hydrogen at 425°C and the measurement by hydrogen chemisorption at 150°C. These features are disclosed in the application as filed (page 3, lines 23 and 31-32). Furthermore, product-by-process features following the expression "obtainable by" have been introduced in claim 1, by reciting the process steps as disclosed in claim 7 and page 5, line 33 to page 6, line 7 of the application as filed. That the content of Co refers to the calcined product can be gathered from page 7, lines 28 and 29, page 8, lines 4-5, 13-14 and 21 to 23 of the application as filed. Thus, the amendments in claim 1 of the main request can directly and

unambiguously be derived from the application as filed. The respondent did not raise any objections under Article 123(2) EPC but argued that the scope of protection of the product claims had been extended, because the calcination temperature of granted claim 7 had not been introduced into the "obtainable-by" features of the product claim.

- 2.1 Granted claim 1 defines and protects a catalyst as such. It is an accepted principle underlying the EPC that a claim to the physical entity per se, such as a product in the form of a catalyst, confers absolute protection upon such physical entity, for all uses of such physical entity, whether known or unknown (Case Law of the boards of appeal of the European patent office, 5th edition 2006, III.B.4). Whether or not the claimed catalyst has been produced by a known or unknown process does not play any role.
- 2.2 Independent claim 7 of the patent in suit is directed to a process claim and defines the calcination temperature being between 200 and 600°C. That temperature limitation was incorporated into the process claim during the examining procedure. The limitation to the calcination temperature is restrictive for that process claim but does not influence the protection conferred by independent product claim 1 as granted. The protection conferred by the two claim categories is to be considered independently. Claim 1 protects the catalyst as such, and is not restricted to how it is produced, whereas claim 7 protects a process and in addition only the catalyst directly obtained by the process (Article 64(2) EPC). Consequently, the protection of the directly

obtained product of the process claim under Article 64(2) EPC does not affect the protection of an independent product claim which is also defined by "obtainable-by" features (see Caw Law, *supra*, II.B.6.1).

- 2.3 Consequently, the allowability of the product claim by "obtainable-by" features without indicating the calcination temperature according to claim 7 as granted only depends on whether or not such an amendment has a basis in the application as filed. There is a proper basis for a process for preparing such a catalyst in the application as filed without indicating the calcination temperature (claims 7 and 9 and page 6, lines 6 and 21). The board does not see any reasons, why the claimed "obtainable-by" features extend the scope of the protection of the granted product claim. Thus, the amendments made to the claims of the main request meet the requirements of Article 123, paragraphs (2) and (3), EPC.

Clarity

3. The definition of Claims 1 according to the main request and to all of the auxiliary requests contain so called "product-by-process" features introduced by the wording "obtainable by", which read as follows:

"obtainable by a process comprising heating a mixture of transition alumina and an aqueous solution of cobalt ammine carbonate to a temperature of 60°C to 110°C in order to allow cobalt hydroxycarbonate to precipitate, drying and calcining the resulting product,".

- 3.1 Since the "obtainable-by" features were introduced by an amendment to claim 1 of the main request in opposition procedure, the requirement of clarity must be met (Case Law, *supra*, VII.C.6.2).
- 3.2 According to the established case law, "claims for products defined in terms of processes for their preparation (known as product-by-process claims) are admissible only if the products themselves fulfil the requirements for patentability and that there is no other information available in the application which could have enabled the applicant to define the product satisfactorily by reference to its composition, structure or other testable parameters" (Case Law, *supra*, II.B.6.1; T 150/82, OJ EPO, 1984, 309, see point 10. and headnote II). As regards the above second requirement, in the present case, information is available in the application as filed, on how to define the catalyst by composition parameters for example by preferred amounts of cobalt, preferred cobalt metal surface area and the type of alumina (see page 5, lines 6 to 17, 24, 25, 30 and 31 as well as claims 3 to 6). None of these possibilities, however, have been introduced in claim 1 of the main request, since the appellant wishes to rely on features such as crystallite size and distribution which are not defined in the application as filed. Since there is no other information available in the application as filed for the desired limitation by reference to crystallite size and distribution, the question arises whether the products themselves as defined by the "obtainable-by" features in claim 1 would fulfil the requirements for patentability.

Prior art documents

- 3.3 The appellant argued that the claimed "obtainable-by" features resulted in distinguishable structural properties over the prior art catalysts according to D4 to D6 such as higher cobalt metal surface area for a given cobalt content, as well as a crystallite size of 3 to 5 nm having a narrow distribution.

Higher cobalt surface area

- 3.3.1 D4 discloses three methods for preparing catalysts comprising cobalt metal on an alumina support, as follows: impregnation of a support with an aqueous solution of cobalt nitrate, pH controlled precipitation, and decomposition of cobalt carbonyl on dehydroxylated alumina (see page 377, left column, Experimental, last paragraph). Table 2 of D4 shows the results of a 3% Co/Al₂O₃ catalyst prepared by decomposition of Co₄(CO)₁₂ on dehydroxylated Al₂O₃ and reduction with hydrogen at different temperatures (300, 350 and 400 °C) with respect to the H₂ uptake, extent of reduction, cobalt dispersion, turnover of CO and activity in the Fischer-Tropsch reaction. A measured H₂ uptake of 33.6 mole/g at a reduction temperature of 400°C indicates, as recalculated by the formula mentioned in the patent in suit (page 3, lines 10 to 15) a cobalt metal surface area of 89 m²/g achieved by a cobalt content of 3% by weight (see respondent's letter of 8 April 2004, page 4, 2nd full paragraph). It has not been contested by the appellant that even at a reduction temperature of 425°C, the measured cobalt metal surface area is still above 40 m²/g of cobalt, as required by claim 1.

3.3.2 D5 discloses a process for the conversion of synthesis gas to a product containing liquid hydrocarbons with an activated, supported catalyst prepared by the steps, in sequence, of

(A) impregnating an alumina or silica support with a cobalt carbonyl,

(B) subjecting said cobalt carbonyl-impregnated alumina or silica support to an activation procedure comprising the steps of, in sequence, (i) reduction in hydrogen, (ii) oxidation with an oxygen-containing gas, and (iii) reduction in hydrogen, said activation procedure being conducted at a temperature below about 450°C, to produce an, activated catalyst having an activity after said step (iii) that is greater than the activity of the catalyst after said step (i), and contacting a synthesis gas comprising hydrogen and carbon monoxide under synthesis conversion conditions with said, activated catalyst to form a product containing liquid hydrocarbons (claim 1).

In example 1, catalyst A is prepared by pretreating gamma alumina with acetone and calcining it at 300°C, then by impregnating the thus pretreated gamma-alumina with dicobalt octacarbonyl in tetrahydrofuran. The catalyst is activated by heating in hydrogen at a temperature of 185°C for one hour. The reduced weight of the catalyst is 12 % by weight of cobalt and 88% by weight of alumina.

According to table III, the hydrogen sorption capacity achieved after hydrogen treatment at 350°C is 0.242 millimoles/gram, which amounts to a cobalt metal surface area of 161 m²/g of Co at that temperature (see

- respondent's letter of 8 April 2004, pages 4-5, which calculation has not been contested). That cobalt metal surface area is above 40 m²/g even at a reduction temperature of 425°C as indicated in claim 1.
- 3.3.3 D6 concerns the role of surface structure and dispersion on CO hydrogenation on cobalt. Cobalt gamma-alumina catalysts are prepared by impregnation with aqueous Co nitrate or by Co carbonyl decomposition by using different types of dehydroxylated alumina supports (page 234, left column, cobalt/alumina catalysts). In that study the dehydroxylation temperature of the alumina support is varied and has a controlling factor in determining the specific activity of the supported cobalt catalyst (see abstract, page 231 and table 3). The Co carbonyl decomposition provides a catalyst containing 3 wt.-% of Co, which after reduction at 350°C has a hydrogen uptake of 17 and 78 micromoles per gram (table 3) corresponding to 47 and 194 m²/g of Co, respectively (respondent's letter of 8 April 2004, page 5, first full paragraph, which calculation has not been contested by the appellant).
- 3.3.4 From the above it follows that the prior art catalysts according to D4 to D6 having a cobalt content in the range of 3 to 40% by weight already provide a cobalt metal surface area of above 40 m² per g of cobalt as defined in claim 1 of the main request.
- 3.4 The appellant argued, however, that the evidence on file showed that the "obtainable-by" features provided a higher cobalt metal surface area at a given cobalt content than any prior art catalyst. In order to prove

this, the processes of D5 and D6 have been reproduced by the appellant in two test reports.

- 3.4.1 The reproduction of D5 has been done by using different amounts of cobalt on two different alumina supports (Puralox HP14/150 and Puralox KR 160) by decomposition of dicobalt octacarbonyl. The alumina supports are gamma aluminas having BET surface areas of 151.1 and 161.7 m²/g and a pore volume of 1.05 and 0.79 cm³/g, respectively (see annex 2, appellant's letter of 17 December 2007).
- 3.4.2 The results on the Puralox HP14/150 support show at a cobalt content of 10% by weight a cobalt metal surface area, as measured under the conditions of claim 1, of 82.4 m²/g. When using a cobalt content of 16.9% and 33.0% by weight, a cobalt metal surface area of 73.5 and 53.2 m²/g, respectively, is achieved (appellant's letter of 28 September 2004, table on page 3). When using a different alumina support (Puralox KR 160) at a cobalt content of 7.55 and 24.8 % by weight, the measured cobalt metal surface area is 34.3 and 61.7 m²/g, respectively (letter of 17 December 2007).
- 3.4.3 D6 has been reproduced by decomposition of Co₄(CO)₁₂ on an alumina carrier. When using a cobalt content of 3.05% by weight, a cobalt metal surface area of 54.6 m²/g is provided. Further catalysts are reproduced according to D6 which contain 17.1 and 30.4% by weight of cobalt and provide a cobalt metal surface area of 65.2 and 54.2 m²/g, respectively (appellant's letter of 28 September 2004, page 3, table). When reproducing D6 with a different alumina support (Puralox KR 160), a catalyst containing cobalt in an amount of 10.8 and

13.2% by weight provides a cobalt metal surface area of 66.1 and 59.1 m²/g, respectively (letter dated 17 December 2007, page 4, table).

- 3.4.4 The results achieved by the appellant's experiments are summarized in a graph (Annex 3, letter dated 17 December 2007), which illustrates the relation between the cobalt metal surface area and the cobalt content. Except for one experiment all reproduced examples of the prior art provide at a cobalt content in the range of from 3 to 40% by weight a cobalt surface above 40 m²/g, in particular above 50 m²/g, and thus meet the composition requirements of the claimed catalyst.

Catalysts produced by the method of invention

- 3.5 Catalyst P2 has been produced by using cobalt ammine carbonate in a slurry method and Puralox HP14/150 alumina. The results show a maximum value of the cobalt surface area of 100.8 m²/g at a cobalt content of 22.8% by weight. At a cobalt content of 18.4% by weight, the cobalt metal surface area is 84.4 m²/g, whilst, at a cobalt content of 19.8% by weight, it is lowered to 71.3 m²/g. After reaching the maximum there is a sharp decrease to 54.7 m²/g at a cobalt content of 35.5% by weight. Then there is a further considerable increase to 63.0 m²/g at a cobalt content of 36.3% by weight. Thus, the relation between the cobalt content and the cobalt metal surface area shows a so-called zig-zag curve and does not follow a continuous curve so that it cannot be reliably concluded that at a specific cobalt content a higher cobalt metal surface than with a prior art catalyst can be achieved.

- 3.5.1 The catalyst P3 has been produced as catalyst P2 but using a higher pore-volume alumina support (see table notes on page 3 of the grounds setting out the appeal). The results show a picture different from catalyst P2. The maximum surface area of 95.9 m²/g is reached at a cobalt content of 30.3% by weight compared to 22.8% by weight for catalyst P2. At a cobalt content of 37.0% by weight the cobalt metal surface area is 82.6 m²/g, which at a comparable cobalt content of 36.3% by weight is only 63.0 m²/g for catalyst P2 and thus more than 19 m²/g higher.
- 3.5.2 The catalysts exemplified in the patent in suit are prepared by using a theta alumina (see page 4, lines 20 to 24) which is the most preferred alumina support (see page 3, paragraph 0023). The results in the table on page 4 of the patent in suit show that a cobalt metal surface area as high as 101.5 m²/g is already achieved at a cobalt content of 13.2% by weight. Such comparable high cobalt metal surface area are achieved with reworked catalysts P2 and P3 when using different alumina supports at a much higher cobalt content (points 3.5 and 3.5.1 above).
- 3.5.3 From the above test results, it can thus be gathered that the measured cobalt metal surface areas at a given cobalt content are not consistent (point 3.5) and that for different alumina supports the cobalt metal surface area is dependent on the amount of cobalt deposited and the type of alumina used (points 3.5.1 and 3.5.2). Thus, the type of alumina and the specific loading of cobalt thereon is not irrelevant. Consequently, a specific relation between the metal content and the cobalt metal

surface area cannot be the inevitable result of the claimed "obtainable-by" features.

- 3.5.4 These conclusions are in line with Fig. 1 of D10, according to which the kind of alumina support has an impact on the cobalt metal surface area as a function of the cobalt content. That the pretreatment of the carrier (dehydroxylation temperature) has an influence on the hydrogen uptake has furthermore been demonstrated in D6 (table 3, page 237).
- 3.5.5 In summary, the appellant's test reports show that catalysts according to D5 and D6 having a cobalt content in the range of 3 to 40% by weight provide a cobalt metal surface area of above 40 m²/g of cobalt when reduced as defined in claim 1. Thus, all these prior art catalysts fulfil the product parameters of claim 1 of the main request, and are thus not distinguishable from catalysts which are arguedly the inevitable result of the "obtainable-by" features. Furthermore, even if the invoked different relation between cobalt content and cobalt metal surface had been shown, it is not a requirement of claim 1.

Crystallite size

- 3.6 The appellant furthermore argued that the "obtainable-by" features provided a crystallite size of 3 to 5 nm and a more uniform distribution than that obtainable by the prior art catalysts.
- 3.6.1 No crystallite particle size or its distribution is ever mentioned in the application as filed, let alone as a possibly distinguishable feature of the claimed

catalyst. Thus, from the patent in suit, no causal relation between the "obtainable-by" features and the crystallite size and its distribution can be gathered. In addition, it is not clear how "uniform" that crystallite size distribution would be. Hence, the board considers that the "obtainable-by" features cannot provide a clearly distinguishable product feature with respect to the crystallite size and its distribution.

3.6.2 Furthermore, according to D4 the cobalt crystallites in this study involve average diameters in the range of 3 to 15 nm (see page 383, left column, second paragraph) which overlap with a particle size of 3 to 5 nm. The appellant's reproduction of D5 provides a Co crystallite size of about 6 nm (Co_3O_4 ; see table on page 4 of appellant's letter dated 17 December 2007), which is so close to the argued different particle size that evidence would be necessary for the board to be able to accept that only the "obtainable by" features produce crystallite sizes of 3 to 5 nm.

3.6.3 The appellant's arguments are mainly based on D10 as evidence that the "obtainable by" feature results in a homogeneous distribution of Co crystallites having a size of 3 to 5 nm. However, that study is related to a high-dispersion-cobalt Fischer Tropsch catalyst (HDC-catalyst, see abstract, first page), which property has not been mentioned in the patent in suit. The catalysts of D10 are prepared by deposition-precipitation by slurring an alumina powder with an appropriate amount of cobalt ammine complex solution. Two aluminas indicated as Sumitono alumina (BET SA 145 m^2/g and pore volume of 0.85 ml/g) and Sasal alumina (148 m^2/g and

pore volume 0.78 ml/g) are employed (see point 2.1 "Catalyst Synthesis").

- 3.6.4 It is noted that the catalyst synthesis of D10 specifically refers to a document indicated with number 12, which is identified as a post published document (WO-A-0187480, published in 2001, see last page of D10). Since the catalyst synthesis in D10 specifically refers to a post published document, there are doubts whether or not D10 provides a proper reproduction of the "obtainable-by" features of claim 1.
- 3.6.5 In addition, the crystallite sizes shown in Fig. 4 of D10 (about 2 to 5 nm) are obtained at a cobalt content as high as 22 % by weight. Furthermore, crystallite sizes of 4.5 to 5 nm are mentioned for a 34% catalyst (paragraph below Fig. 5, lines 3 and 4). Thus, the crystallite sizes indicated in D10 are only shown for a high cobalt content above 20% by weight, which is neither exemplified in the application as filed nor disclosed as preferred. It is noted that the size of crystallites on supports is not independent on the catalyst loading. Thus, it cannot be concluded from D10 that at a lower cobalt content, which is in the preferred and exemplified range of the patent in suit the "obtainable-by" features would inevitably result in the same "uniform distribution of Co crystallite sizes of 3 to 5 nm".
- 3.6.6 Furthermore, claim 1 of the main request does not specify, in which form the "crystallites", if any, are present as the inevitable result of the "obtainable by" features. In D4, reference is made to the metal crystallite size (page 383, left column), whilst

according to D10 the crystallites may be present in the form of CoO , Co_3O_4 and Co-metal dependent on the reducing conditions (see Fig. 4). Crystallite sizes of cobalt oxides or metallic cobalt may have different sizes which are not only influenced by the precipitation conditions defined by the claimed "obtainable-by" features but also by the pretreatment history such as drying, calcination and reducing conditions (D10, page 2, first paragraph; Fig. 4). None of these last process conditions are specifically indicated in the product-by-process formulation, so that said crystallite size, let alone its "homogeneous size distribution", cannot be treated as the inevitable result of the "obtainable-by" product features.

3.6.7 According to the case law (T 552/91 OJ, 1995, 100, Reasons 5.2) "it is necessary to include in the claim the process parameters required for defining unambiguously the claimed substances as inevitable process products". "It is generally necessary to indicate not only the starting compounds and the reaction conditions, but also the methods by which the reaction mixture is processed to obtain the claimed compounds". Without clearly indicating the specific starting materials (including the alumina carrier having specific pore volume and surface area) and the specific reaction conditions (drying, calcination and reducing conditions), the "obtainable-by" features as claimed fail to unequivocally define any clear catalyst features.

3.7 In summary, the claimed obtainable-by feature does not unambiguously define the claimed catalysts as inevitable process products. Furthermore, the exact

distinction (a specific relation between cobalt content and cobalt metal surface area or a more uniform Co crystallite size distribution of 3 to 5 nm), which should define the scope of protection, cannot be learnt from the obtainable-by features, since the experimental evidence on file does not show that the "obtainable-by" features necessarily provide any clearly distinguishable product feature in that respect. Consequently, the product-by-process features of claim 1 of the main request is not clear and does not permit the conclusion that the inevitable process product thereof is novel over the prior art catalysts.

- 3.8 Therefore, the product-by-process features in claim 1 of the main request do not clearly define patentable subject-matter and the claim does not meet the requirements of Article 84 EPC.

Auxiliary request 1 and 3

Amendments

4. Claim 1 of auxiliary request 1 differs from claim 1 of the main request only in that the cobalt content has been specified to be 10 to 40% by weight. The lower percentage is disclosed on page 5, line 31, according to which the cobalt catalyst contains more preferably 10 to 20% by weight. Thus, the claimed range is based on a combination of a more preferred range with the general range of 3 to 40% by weight and completely includes the more preferred range. That amendment is in line with the established case law, according to which a combination of the preferred disclosed narrower range and one of the part-ranges lying within the disclosed

overall range on either side of the narrower range is unequivocally derivable from the original disclosure (Case Law, *supra*, III.A.2.1; see T 925/98 of 13 March 2001, point 2.).

- 4.1 Claim 1 of auxiliary request 3 differs from claim 1 of the main request only in that the cobalt content has been specified to be 10 to 20% by weight. That weight percentage is specifically disclosed on page 5, line 31 of the application as filed.
- 4.2 Furthermore, the additional amendments made to auxiliary requests 1 and 3 do not extend the protection conferred by the claimed subject-matter. Consequently, the amendments meet the requirements of Article 123, paragraphs (2) and (3) EPC.

Admissibility of the product-by-process features

5. In claims 1 of auxiliary requests 1 and 3 the amounts of cobalt have been specified to 10 to 40 and 10 to 20% by weight, respectively. However, these features do not provide any further distinctions over the cited prior art, since according to D5 a cobalt content of 12% by weight provides a surface metal area of more than 40 m²/g of cobalt (see Reasons, points 3.2.2 above) as confirmed by the appellant's experiments (see point 3.4.2 above). Furthermore, such a limitation does not change the wording of the "obtainable-by" features and does not include any further necessary process parameters required for defining unambiguously the claimed catalysts as inevitable process products as discussed for the main request (Reasons, point 3.5.5, 3.6, 3.7 and 3.8 above). Consequently, the same

arguments as indicated for the main request apply *mutatis mutandis* to claim 1 of auxiliary requests 1 and 3 so that they are not admissible as well. Consequently, the auxiliary requests 1 and 3 are not allowable under Article 84 EPC.

Auxiliary request 2

6. Claim 1 of auxiliary request 2 differs from claim 1 of the main request only in that the cobalt content has been specified to be 20 to 40% by weight. As a basis for that amendment, the appellant referred to page 5, line 31 according to which the cobalt catalyst contains preferably 5 to 20% by weight and more preferably 10 to 20% by weight.

However, according to the application as originally filed 20% by weight does not represent a lower limit. In fact, none of the preferred ranges is included in that range. In addition, none of the exemplified catalysts of the patent in suit illustrate the now claimed weight percentages. Consequently, the claimed range with a lower limit of 20 by weight cannot be directly and unambiguously derived from the application as filed (Case Law, T 925/98, cited *supra*). On the other hand, besides failing to meet the requirements under Article 123(2) EPC, such a request would also not be allowable under Article 84 EPC, for the same reasons as given for auxiliary requests 1 and 3 under point 5. above.

Auxiliary request 4

Amendments

7. Claim 1 of auxiliary request 4 corresponds to claim 1 of auxiliary request 1, except for the following features being added after the words "calcining the resulting product":

"at a temperature of from 200 - 600°C and activating the product with hydrogen gas at temperatures between 350 and 550°C".

The calcination temperature is disclosed on original page 6, line 29 and the activating step is disclosed on original page 6, lines 31 to 33. Thus, these amendments have a proper basis in the application as originally filed and do not extend the protection conferred (Article 123, paragraphs (2) and (3), EPC).

Admissibility

8. In claim 1 of auxiliary request 4, in addition to claim 1 of auxiliary request 1, the temperature of calcination and activation with hydrogen has been specified. However, these additional features do not provide any further distinctions over the prior art described in D5, as can be gathered from the following:

- 8.1 According to D5, the dried catalyst is calcined in flowing air at a temperature in a range of 200 to 400°C to decompose the metal salts and fix the metals (column 4, lines 58 to 63). That calcination temperature is completely within the claimed range of

200 to 600°C. The activation of the catalyst according to D5 is carried out with hydrogen at a temperature below 500°C (see column 5, lines 25 to 30) and in particular at a temperature of 350°C (see example 1, R350, column 7, lines 20 to 24). Thus, the activation temperature specified in D5 is completely within the claimed range of 350 to 550°C.

8.2 Although the "obtainable by" feature more specifically indicates, under which reaction conditions the catalyst is prepared, the objections raised with respect to the main request and auxiliary requests 1 and 3 still apply to auxiliary request 4 for the following reasons:

8.2.1 The appellant has no longer argued that the further amended process conditions provide a distinguishable relation between the cobalt content and the cobalt surface area. The same arguments presented for the main request (Reasons, point 3.5.5, 3.7 and 3.8 above) and for auxiliary request 1 (Reasons, point 5 above) also apply *mutatis mutandis* to auxiliary request 4 as well.

8.2.2 As regards the crystallite particle size and its homogeneous distribution, the board notes that neither the specific kind of Al₂O₃ support nor the surface area thereof and/or its pore volume are indicated in claim 1. It cannot be concluded that these features are irrelevant for the argued different cobalt crystallite size and its distribution (see also Reasons, points 3.7 and 3.8).

8.3 Consequently, since not all of the necessary conditions such as starting components and process conditions are clearly indicated in the "obtainable by" feature, for

defining unambiguously the claimed catalysts as inevitable process products (a more uniform Co crystallite size distribution of 3 to 5 nm), the claimed product-by-process feature of claim 1 of auxiliary request 4 does not provide a clearly distinguishable product feature (Article 84 EPC).

Auxiliary request 5

9. Claim 1 of auxiliary request 5 differs from claim 1 of auxiliary request 4 in that the cobalt metal surface area has been specified to be above 80 m² per g of cobalt. That cobalt area is disclosed on page 5, line 25 and in claim 4 of the application as filed and limits the scope of protection. Consequently, the amendments in claim 1 of auxiliary request 5 cannot be objected under Article 123, paragraphs 2 and 3, EPC.

9.1 As regards the amended cobalt metal surface area, D5 already discloses a hydrogen sorption capacity of catalyst A after hydrogen treatment at 350°C of 0.242 millimoles/gram, which amounts to a cobalt metal surface area of 161 m²/g of Co (see point 3.3.2 above). That cobalt metal surface area is above 80 m²/g as recited in claim 1 of auxiliary request 5. The appellant's reproduction of D5 confirms that at a cobalt content of 10% by weight a cobalt metal surface area as measured under the conditions of claim 1 of 82.4 m²/g within the claimed range can be achieved (see point 3.4.2). Consequently, the amended product features (cobalt content and Co metal surface area) are met by the prior art catalysts.

9.2 The "obtainable by" features as such are not different from those of claim 1 of auxiliary request 4 so that the reasons for refusing auxiliary request 4, that the "obtainable-by" features do not include all necessary process parameters for defining unambiguously the claimed catalysts as inevitable process products, apply *mutatis mutandis* to claim 1 of auxiliary request 5 (Reasons, point 8. above). Thus, the claimed "obtainable-by" features do not provide a clearly distinguishable product and claim 1 does not meet the requirements of Article 84 EPC.

10. From the above it follows that neither claim 1 according to the main request nor claim 1 of any of the auxiliary requests 1 to 5 meet the requirements set a out in Article 84 EPC.

Auxiliary request underlying the decision under appeal

11. The auxiliary request by which the patent was maintained in amended form by the opposition division has not been challenged by the proprietor as the sole appellant. Thus, neither the board nor the non-appealing opponent can challenge maintenance of the patent as thus amended (Case Law, VII.D.6.1; no *reformatio in peius*). In that version the patent remains in force.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

C. Eickhoff

S. Perryman