

Internal distribution code:

- (A) [] Publication in OJ
(B) [] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 30 June 1999

Case Number: T 0454/96 - 3.3.5

Application Number: 89309485.4

Publication Number: 0360548

IPC: B01D 53/36

Language of the proceedings: EN

Title of invention:

A process for producing a denitration catalyst

Patentee:

Babcock-Hitachi Kabushiki Kaisha

Opponent:

Siemens AG

Headword:

Denitration catalyst/BABCOCK-HITACHI

Relevant legal provisions:

EPC Art. 56, 123

Keyword:

"Inventive step - yes, non-obvious solution of a technical problem"

Decisions cited:

-

Catchword:

-



Europäisches
Patentamt

European
Patent Office

Office européen
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 0454/96 - 3.3.5

D E C I S I O N
of the Technical Board of Appeal 3.3.5
of 30 June 1999

Appellant: Babcock-Hitachi Kabushiki Kaisha
(Proprietor of the patent) 6-2, 2-chome
Ohtemachi Chiyoda-ku
Tokyo 100 (JP)

Representative: Pendlebury, Anthony
Page, White & Farrer
54 Doughty Street
London WC1N 2LS (GB)

Respondent: Siemens AG
(Opponent) Abtlg. ZFE GR PA 3
Postfach 22 16 34
80506 München (DE)

Representative: -

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 11 March 1996
revoking European patent No. 0 360 548 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: R. K. Spangenberg
Members: G. J. Wassenaar
M. B. Günzel

Summary of Facts and Submissions

I. The appeal is from the decision of the Opposition Division to revoke European patent No. 0 360 548, which was granted in response to European patent application No. 89 309 485.4.

II. The decision under appeal was based on two sets of amended claims. Inter alia the following documents were cited:

D1: US-A-4 285 838

D2: DE-B-2 846 476.

In the decision under appeal the subject matter of independent claims 1 and 4 of the main request and claim 1 of the auxiliary request were regarded as lacking an inventive step in view of D2 in combination with the general knowledge of the skilled person. The Opposition Division considered that the technical problem to be solved was essentially to create a catalyst with a high peeling-off strength and that this problem was identical to the technical problem solved by D2.

III. With the statement of grounds of appeal, the appellant submitted new claims 1 to 7 as main request and new claims 1 to 3 as auxiliary request. Later in the proceedings a declaration of Akira Kato, a joint inventor of D2 and a declaration of Yasuyoshi Kato, comprising repetitions of Examples 3 and 4 of D2, were submitted. During oral proceedings, which were held on 30 June 1999, an amended set of seven claims was

submitted, which replaced the above-mentioned claims according to the main request.

Claim 1 of this set reads as follows:

"A process for producing a denitration catalyst for reducing with ammonia nitrogen oxide contained in an exhaust gas, which comprises adding water to catalyst raw materials, which materials upon calcination afford titanium oxide, molybdenum oxide and, optionally, vanadium oxide; making a slurry, the water content in said slurry being made 35 to 50% by weight; supporting said slurry on a metal substrate; and drying the product; characterised in that the respective mole proportions of Ti/Mo/V are in the range 97-65/3-20/0-15 percent and said catalyst raw materials are calcined before slurrying or being supported on the substrate, and powdered, wherein said metal substrate is an expanded metal lath with a plurality of openings and is coated with a slurry of catalyst raw materials by immersion so that the quantity of said catalyst supported onto said metal substrate is in the range of 100 to 200 g/m², wherein the surface area in this case refers to a projected area of one surface of the catalyst including the openings of the expanded metal, wherein the openings of the expanded metal lath are prevented from clogging with the slurry, by removing superfluous slurry from the openings."

The problem underlying the invention was regarded as being the provision of a denitration catalyst with high catalytic activity and high peel-off strength which uses a relatively low quantity of catalyst components whereas D2 was principally aimed at providing a

catalyst of high mechanical strength and good adhesive strength. In the written and oral proceedings it was essentially argued that, contrary to the patent in suit, D2 required that the slurry coated on the metal wire mesh had a paste-like consistency with a low water content and that D2 did not disclose or suggest preventing the openings of the wire mesh from clogging as required by the patent in suit. D1 disclosed the use of an expanded metal lath but did not disclose or suggest the prevention of clogging. On the contrary, in the specifically disclosed and illustrated catalysts having an expanded metal lath as support, the openings therein were completely covered with the catalyst material. It was submitted that the conclusion drawn by the Opposition Division was essentially a reconstruction with hindsight of the invention based on unsupported assumptions about the teaching of D2 and that it would not have been obvious to one of ordinary skill at the priority date of the patent in suit to have taken the teaching of D2 and arrived at a process for producing a catalyst having all the features of present claim 1.

- IV. The respondent contested the appellant's arguments and submitted that the subject matter of the independent claims of all requests lacked an inventive step over D2. It was argued that in the patent in suit and in D2 the same problem was indicated, ie to provide a catalyst having high mechanical strength and good adhesion to the carrier. It was further argued that the new feature introduced in the independent claims, ie the removal of superfluous slurry from the openings, was not sufficiently disclosed in the patent in suit so that this amendment was not allowable under

Article 123(2) EPC. Moreover, the removal of superfluous slurry was also disclosed in D2. It was not contested that in the Examples 3 and 4 of D2, repeated by the appellant, the openings in the supporting metal mesh were filled, but it was argued that the teaching of D2 was much broader and included conditions whereby the openings in the mesh remained free. In particular Figure 4 of D2 revealed that the water content of the slurry to be applied on the wire mesh could have a water content within the terms of present claim 1 so that by immersing the wire mesh in the slurry and removal of superfluous slurry clogging of the openings was automatically prevented. If the wire mesh was replaced with an expanded metal lath, the result would have been the same. Such a replacement was obvious in view of D1, disclosing an expanded metal lath as support for the same kind of catalytic material. Since according to the patent in suit the openings in the expanded metal lath occupied about 79% of the surface area it was obvious that only 29% of the catalytic material was needed for the unclogged coating of such a lath compared with the full coverage of a wire net or a metal plate. In view of the fact that conventional supported catalysts contained 800 to 1000 g/m² of catalyst material and the catalysts obtained by repeating Examples 3 and 4 of D2 comprised 690 and 1200 g/m² of catalytic material respectively, it was obvious to apply 100 to 200 g/m² catalytic material as now claimed.

With respect to product claim 4 of the main request, essentially defined by the process features according to claim 1, no additional objections were raised.

- V. The appellant (patentee) requested as its main request that the decision under appeal be set aside and that the patent be maintained in amended form with claims and description as filed during oral proceedings and drawings as granted. As first auxiliary request, the appellant requested to maintain the patent with the claims as filed with its "Auxiliary Request" on 18 July 1996. As second auxiliary request, the appellant requested to maintain the patent with claims 1 to 3 of the main request filed in the oral proceedings with the other claims deleted.

The respondent (opponent) requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
- 2.1 Amendments (Article 123 EPC)

Claims 1 and 4 contain the additional requirement that the openings are prevented from clogging with the slurry **by removing superfluous slurry from the openings**. This limitation is based on the general statement in the description as originally filed that the process of applying the slurry may be carried out by **immersing the substrate in the slurry, removing superfluous liquid by a centrifugal separator, blowing off, suction, impact or the like means** and drying, and

the more specific statement in Example 1 with respect to applying the slurry on an expanded metal lath reading: "**The object of removing the superfluous slurry by means of a centrifugal separator is to prevent the openings of the expanded metal from clogging with slurry and to obtain a porous metal plate catalyst. As to the process of the centrifugal separation can be replaced by air-flowing, vibration-impacting, etc.**" (page 8, lines 3 to 8 and page 10, last two full sentences of the application as originally filed). The Board cannot, therefore, accept the respondent's argument that the phrase "by removing superfluous slurry from the openings" is an unallowable generalisation. In the Board's judgement it is clear from the above citations from the original application that the centrifugal separator is only one means of removing slurry from the openings and that the original disclosure includes any means for removing the slurry which prevents the openings from clogging. The Board can neither accept the respondent's argument that claim 1 now requires that superfluous slurry is exclusively removed from the openings and that this is not disclosed. In the Board's view, the mentioning in claim 1 that superfluous slurry is removed from the openings does not mean that no slurry is removed from the metal parts around the openings. Such a process would in fact be practically impossible and is not claimed by present claim 1 as interpreted in the light of the description. The amendment in claims 1 and 4 is thus based on the original disclosure and does not extend the protection conferred; it fulfils the requirements of Articles 123(2) and (3) EPC. The other amendments also fulfil these requirements. Since this

was not contested, there is no need to discuss them here.

2.2 Novelty

Lack of novelty was raised as an opposition ground but not maintained at the appeal stage. From the following evaluation of inventive step it is evident that the Board holds that the subject matter of the claims on file is novel. Since the novelty of the claims on file has not been contested there is no need to give further reasons relating to this issue.

2.3 Inventive step

- 2.3.1 It is uncontested that D2 represents the closest prior art. It discloses a process for producing a denitration catalyst for reducing with ammonia nitrogen oxide contained in an exhaust gas, which comprises adding water to catalyst raw materials to form a pasty slurry, which materials upon calcination afford titanium oxide, molybdenum oxide and, optionally, vanadium oxide, drying the paste and precalcining the raw materials to form an oxide mixture, forming a powder of the oxide mixture, adding water to the powder to form a pasty slurry, supporting said slurry on a metal wire mesh or a porous steel plate and drying and calcining the product (column 6, line 59 to column 7, line 28, column 8, line 34 to column 9, line 11 and Examples 3 and 4). The result of the peeling-off dropping test of the catalysts obtained in Examples 3 and 4 was in both cases 0.5%. With the catalyst obtained in Example 4 of D2 a denitration of 89% could be obtained; see Example 5 of D2.

D2 does not disclose the amount of catalyst on the support. According to the experiments of Yasuyoshi Kato, filed during the appeal proceedings, the amounts of catalyst supported on the wire net according to Example 3 was 690 g/m² and on the steel plate according to Example 4 was 1200 g/m². These data were not contested and are in agreement with data given in the description of the patent in suit for prior art supported catalysts (800 to 1000 g/m²) and in comparative Example 2 of the patent in suit (820 g/m²).

- 2.3.2 In agreement with the submissions made by the appellant and the statements in the patent in suit (page 2, lines 33 to 42) the problem underlying the invention can be seen in providing a more economic denitration catalyst having a high activity and peeling-off resistance. According to claim 1 this problem is solved by using an expanded metal lath as catalyst carrier, a coating slurry with a water content of 35 to 50% and such coating conditions that the quantity of catalyst material supported onto the metal lath is in the range of 100 to 200 g/m² (as defined in claim 1) and the openings in the metal lath are prevented from clogging with the slurry by removing superfluous slurry therefrom.

The figures for percentage denitration (maximum 81%) and peeling-off resistance (best result 12%) in the patent in suit are not quite as good as those given in D2 but the measurement conditions are not identical and do not allow a direct comparison. From the comparative examples in the patent in suit it follows that with the catalysts obtained according to the process of the patent in suit, with 1/5 or less the quantity of

catalyst material, the same degree of denitration and peeling-off is obtained as with a catalyst with conventional production processes (page 7, lines 22 to 24). The comparative conventional processes were essentially performed in agreement with D2. These findings were not contested. On this basis the Board is satisfied that the process according to claim 1 actually solves the above-mentioned problem. It remains to be decided whether the claimed solution was obvious to the skilled person trying to solve the problem having regard to the prior art.

2.3.3 D2 does not contain any lead towards the claimed solution. The Board cannot accept the respondent's argument that D2 discloses coating slurries containing more than 35% water (Figure 4), which slurries, when applied to an expanded metal lath, automatically result in catalysts according to present claim 4. Fig.4 of D2 discloses graphically the relationship between the most suitable amount of water to be added to a molybdenum oxide containing titanium oxide powder for obtaining a coating slurry and the precalcination temperature of the powder. From this figure it can be deduced that for a slurry to be applied to a metal wire mesh (curve B) at precalcination temperatures below 500°C the amount of water to be added should be above 35% (maximum 42%). According to D2 high amounts of water are however not preferred since the lower the amount of water added, the better the mechanical stability of the sintered products (column 10, lines 8 to 11). For coating on a wire net the most suitable amount of water to be added is 20 to 30% by weight (column 8, lines 62 to 67).

But even if the skilled person considered adding an

amount of water of 42% he would obtain a slurry comprising only 29.5% water and would not obtain a product according to claim 4, since in the Board's judgement and in agreement with the appellant's submission, the amount of water relates to the weight of the dry powder. The respondent's allegation that the amount of water mentioned in D2 should be read as the amount of water with respect to the slurry obtained after the addition of water cannot be accepted. The fact that in D2 the amount of the oxide components in the starting composition or the powder is given in weight percent with respect to the total composition does not mean that the amount of water should also be related to the total composition; ie to the amount of slurry. In a multi-component system such as a composition of the oxides of Ti, Mo and V, the compounds can only be related to the total composition. In the case of a dual composition such as water and a powder there are two possibilities, which are both common in the art. Whether the amount of water is related to the amount of powder or to the amount of slurry obtained after mixing depends upon the actual wording. Throughout D2 the amount of water is referred to as to the amount added to the powder mix; ie related to the weight of the powder. This is particularly clear in Example 9 where it is said that 140 ml water per 1 Kg powder is added (Dem erhaltenen Pulver wurden 140 ml Wasser pro 1 Kg des Pulvers zugesetzt.) The Board is therefore convinced that in D2 the amount of water is related to the amount of powder and that even the highest possible amount of water which can be derived from D2 is lower than required by present claim 1. Thus no process according to D2 leads automatically to a product according to present claim 4.

2.3.4 The Board further observes that, even if, in the respondent's favour, the amount of water in D2 were to be calculated on the same basis as in the patent in suit, the use of 42% water in the slurry would not have automatically provided a coated wire mesh with free openings. As indicated in Example 1 of the patent in suit special means are generally necessary, such as a centrifugal separator, in order to prevent the openings from clogging. No such means are disclosed in D2. Only at the high end of the water content (50%) it is perhaps possible that after immersion of the wire mesh in the slurry superfluous slurry is simply dripped off leaving the openings free. Apart from the fact that D2 does not teach the immersion of a wire mesh in a slurry, there is no evidence that a slurry according to D2 allegedly containing 42% of water would have such a low viscosity that by simple immersion and removal from the slurry an open catalyst structure is obtained. Such a process would in fact be completely against the general teaching of D2 to use a water-powder mixture which is viscous and can be kneaded (claim 1). In particular, Figure 4 does not disclose that a slurry obtained by adding 42% water to a powder precalcined at a temperature below 500°C would have the required low viscosity. In the Board's judgement, this figure has to be interpreted in the light of the said general teaching, which is in conformity with the corresponding explanations in the description (see column 10, lines 5 to 8 in combination with column 9, lines 52 to 60).

2.3.5 D1 does not provide any incentive to the skilled person for making a plate-like catalyst with free openings. It discloses the use of an expanded metal lath as support for the same kind of catalyst material, but requires

that the catalyst material is present at both sides and is anchored through the openings to increase the cohesion of the catalyst (column 5, lines 39 to 48). Figures 15 to 21 clearly indicate that if the support is an expanded metal lath or any other essentially flat structure with openings, the openings are completely filled with the catalyst material. Combining the teaching of D1 with D2 may make the replacement of the wire mesh in D2 with an expanded metal lath obvious but not the modified coating method according to present claim 1 which yields a flat catalyst with unplugged openings.

2.3.6 The other documents on file do not provide any incentive for the claimed solution either. Since in the appeal proceedings the respondent only relied on D1 and D2, there is no need to discuss any of the other documents.

2.3.7 The respondent further argued that, since according to the patent in suit an expanded metal lath has about 79% of its surface occupied by openings (Example 1) and conventional supported catalysts contain 800 to 1000 g/m² catalyst material (page 4, lines 44 to 45) it was obvious to use only about 1/5 of this amount, ie within the limits required by claim 1, if an expanded metal lath is used as support. In the Board's judgement, this argument is based on hindsight. It would only apply after the skilled person had considered that a supported catalyst with free openings would solve the technical problem set out in item 2.3.2

above. Since for the reasons given above the skilled person had no incentive to consider such a structure, this argument is not relevant for assessing the inventive step.

- 2.3.8 For these reasons the Board holds that the solutions for the above-mentioned problem as claimed in process claim 1 and product claim 4 do not follow in an obvious manner from the state of the art and therefore involve an inventive step. The inventive step of the subject-matter of the other claims follows from their dependency upon either claim 1 or claim 4.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent with claims 1 to 7 as filed during oral proceedings, the description as filed during oral proceedings and the drawings (Figures 1 to 8) as granted.

The Registrar:

The Chairman:

S. Hue

R. Spangenberg