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D E C I S I O N
of 13 January 2005

Case Number: T 0537/99 - 3.3.1

Application Number: 91912965.0

Publication Number: 0539433

IPC: C07C 7/148

Language of the proceedings: EN

Title of invention:

Process for adsorbing sulfur species from propylene/propane
using regenerable adsorbent

Patentee:

ExxonMobil Chemical Patents Inc.

Opponent:

Fina Research S.A.

Headword:

Desulfurisation/EXXONMOBIL

Relevant legal provisions:

EPC Art. 56, 123(2)(3)

EPC R. 57a

Keyword:

"Rule 57a EPC - amendments occasioned by grounds of opposition
(yes)"

"Inventive step (yes) - problem solved by whole scope of
claimed method - non-obvious solution"

Decisions cited:

-

Catchword:

-



Case Number: T 0537/99 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 13 January 2005

Appellant: ExxonMobil Chemical Patents Inc.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 18 March 1999
revoking European patent No. 0539433 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: A. J. Nuss
Members: P. P. Bracke
S. C. Perryman

Summary of Facts and Submissions

- I. European patent No. 0 539 433 was granted with nine claims. The only independent claim read:

"1. A method of removing sulfur components from an olefinic hydrocarbon stream containing C₂ and/or C₃ and/or C₄ olefins comprising contacting the hydrocarbon stream containing at least one sulfur species selected from the group consisting of **mercaptans, organic sulfides** and disulfides with a metal oxide catalyst capable of adsorbing said sulfur species in the absence of extraneously added hydrogen at a pressure within the range 0 to 138 barg (0 to 2000 psig) and a temperature in the range 50 C to 175°C said metal oxide being selected from the group consisting of **cobalt oxide, nickel oxide, molybdenum oxide, zinc oxide and copper oxide and mixtures of at least two members selected from the group consisting of cobalt oxide, nickel oxide, molybdenum oxide, zinc oxide and copper oxide.**"

(emphasis added)

- II. The Opposition Division revoked the patent since the claimed method of the then pending sets of claims according to the main and auxiliary request was not novel respectively not inventive over the disclosure of document

(2) EP-A-0 016 284.

- III. At the oral proceedings before the Board, which took place on 13 January 2005, the Appellant filed sets of claims according to a New Main Request, a First Auxiliary Request and a Second Auxiliary Request.

The New Main Request consisted of 9 claims with the sole independent claim reading:

"1. A method of removing sulfur components from an olefinic hydrocarbon stream containing C₂ and/or C₃ and/or C₄ olefins comprising contacting the hydrocarbon stream containing at least one sulfur species selected from the group consisting of; **methyl sulfides, ethyl sulfides, propyl sulfides and mixtures thereof**; and disulfides, with a metal oxide catalyst capable of adsorbing said sulfur species in the absence of extraneously added hydrogen at a pressure within the range 0 to 138 barg (0 to 2000 psig) and a temperature in the range 50 C to 175°C said metal oxide being selected from the group consisting of **mixtures of cobalt and molybdenum oxides, or nickel and molybdenum oxides and nickel oxide.**" (emphasis added)

IV. The Appellant essentially argued, that document (2) represented the closest state of the art, that starting from the teaching of document (2) the problem to be solved was the provision of a further method for removing methyl sulfides, ethyl sulfides and/or propyl sulfides from an olefinic hydrocarbon stream containing C₂ and/or C₃ and/or C₄ olefins and that the claimed method was not obviously derivable from the cited state of the art.

V. The Respondent contested that the requirement of Rule 57a EPC was fulfilled and he argued that document

(1) GB-A-1 142 339

represented the closest state of the art, that with the data presented in the patent in suit it had not been made plausible that methyl sulfides, ethyl sulfides and/or propyl sulfides were effectively removed from an olefinic hydrocarbon stream containing C₂ and/or C₃ and/or C₄ olefins and that, starting from the method described in document (1), the claimed method was obvious in view of the disclosures of documents (2) and

(5) US-A-0 3 642 927.

VI. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the claims of the New Main Request or of the First Auxiliary Request or of the Second Auxiliary Request, all submitted at the oral proceedings on 13 January 2005.

The Respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Rule 57a EPC

Rule 57a EPC stipulates, that the claims may be amended "... provided that the amendments are occasioned by grounds of opposition ..."

It was not contested that the restrictions in Claim 1 of

- the sulphur species contained in the treated hydrocarbons and
- the metal oxides used in the claimed method

(see the emphasised passages in Claim 1) were occasioned by inventive step objections over the cited prior art. Therefore, the requirement of Rule 57a EPC is fulfilled.

Nevertheless, referring to T 347/02, the Respondent submitted that Rule 57a EPC not only requires that the amendments must be occasioned by a ground of opposition, but that it must also be specified which prior art citation renders its introduction necessary.

However, in T 347/02 an amendment was not allowed, because the amendment itself was not clear (see point 6 of the Reasons of the Decision). The statement in point 5(ii) of the Reasons of the Decision that it was not clearly indicated which prior art citation renders necessary its introduction in response to which substantive objection, cannot be read in isolation as implying that there is an absolute requirement under Rule 57a EPC explicitly to specify which prior art citation renders the introduction of the amendment necessary.

2.2 Article 123(2) and (3) EPC

Since the only ground of opposition was Article 100(a) EPC, according to the jurisprudence of the Boards of

Appeal, the Board does not have the right to allow objections which do not arise out of the amendments made after the grant of the patent. As present Claim 1 differs from granted Claim 1 only by the nature of the selected sulfur species in the hydrocarbon stream and by the selected metal oxides used (see the emphasised passages in Claim 1), the question arises whether those amended features were supported by the application as filed.

2.2.1 Since original Claim 4 specifically discloses that the used metal oxide may be selected from the group consisting of cobalt oxide, nickel oxide, a mixture of cobalt and molybdenum oxides and a mixture of nickel and molybdenum oxides, also the selection of the metal oxides in present Claim 1 was directly and unambiguously disclosed in the application as filed.

2.2.2 The Respondent contested that there was support in the application as filed for a method of removing methyl sulfides, ethyl sulfides and propyl sulfides.

However, in the paragraph bridging pages 6 and 7 of the application as filed it was stated that the hydrocarbon stream includes at least one sulfur species selected from the group consisting of mercaptans, organic sulfides and disulfides and on page 7, lines 27 to 29, it was stated that the sulfides may be selected from the group consisting of methyl sulfides, ethyl sulfides and propyl sulfides. Therefore, it was directly and unambiguously disclosed in the application as filed that the sulfur species to be removed could be selected from the group consisting of methyl sulfides, ethyl

sulfides and propyl sulfides within the group of organic sulfides.

2.2.3 Claims 2 to 9 correspond with original Claims 6, 8, 11, 14, 26, 28, 29 and 33.

2.2.4 In comparison with the granted set of claims, the amendments result into a restriction of the claimed scope.

2.2.5 Consequently, the set of claims meets the requirements of Article 123(2) and (3) EPC.

2.3 Novelty

Since the features of the claimed method are not all disclosed in any one of the cited prior art documents, the claims as granted meet the requirement of novelty. As this was not further contested, it is not necessary to give a more detailed reasoning as to whether the requirement of novelty is met.

2.4 Inventive step

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

2.4.1 There was dispute whether document (1) or document (2) represented the closest state of the art (see points IV and V above).

In selecting "the closest state of the art", the first consideration is that it must be directed to **the same purpose** as the claimed invention. Otherwise, it cannot lead the skilled person in an obvious way to the claimed invention (see Case Law of the Boards of Appeal of the European Patent Office, 4th edition 2001, I, D, 3.2). With a prior art not directed to **the same purpose** as starting point, any attempt to establish a logical chain of thought which could lead to the claimed invention, inevitably gets stuck from the outset.

In particular, where the background to the invention lies in difficulties encountered in known methods, the documents to be considered when determining the closest state of the art are those which describe such methods.

Document (1) discloses a method for removing carbon oxysulfide (COS) from hydrocarbon fractions and document (2) discloses a method of removing high boiling sulfurous impurities, such as dimethyl sulfide, from a C₄ olefinic hydrocarbon stream. As, thus, document (1) is not concerned with the removal of the same sulfur compounds as the claimed method, whereas document (2) is concerned with the removal of the same sulfur compounds from the same olefinic hydrocarbon stream as in the claimed method, document (2) is directed to the same purpose as the claimed invention and, therefore, constitutes a more suitable starting point for assessing inventive step.

2.4.2 Document (2) discloses a method for desulfurising a butene-containing C₄ hydrocarbon feed stream containing hydrogen sulfide, COS, methyl mercaptan and high boiling sulfurous compounds (e.g. dimethyl sulfide) by passing the feed stream through a desulfurisation zone containing at least one desulfurisation medium capable of adsorbing, absorbing or converting hydrogen sulfide, COS and methyl mercaptan to high boiling sulfurous compounds, passing the thus-treated feed stream, essentially free from hydrogen sulfide, COS and methyl mercaptan to a distillation zone and recovering as an over-head product from the distillation zone a substantially sulfur-free butene-1 rich stream (see the only full paragraph on page 3). Zinc oxide is described as a suitable desulfurisation medium in the paragraph bridging pages 5 and 6.

2.4.3 The Appellant submitted that, starting from document (2), the problem to be solved consisted in providing a **further** method of removing sulfur from an olefinic hydrocarbon stream containing C₂ and/or C₃ and/or C₄ olefins.

2.4.4 The patent in suit claims to solve this problem by the method defined in Claim 1.

2.4.5 The Respondent alleged, that with the sole data available, namely those in examples I to III of the patent in suit, it had not been made plausible that the problem as defined in point 2.4.3 above had been effectively solved. In particular, he submitted, that with the data for run 5 in Table 1 (example II), showing an increase of the amount of sulfur instead of a reduction thereof, and with the data in runs 2, 3

and 4 in Table 2 (example III), showing no reduction or only a slight reduction of the sulfur content, the Appellant himself had shown that the problem as defined in point 2.4.3 above had not been effectively solved.

However, it has not been contested, that the data provided in example I, in runs 1 to 4 and 6 to 8 in Table 1 (example II) and in run 1 in Table 2 (example III) unambiguously show that at least some removal up to a removal of 95% is obtained by using the metal oxides and the temperature and pressure conditions specified for those runs and embraced within the wording of Claim 1.

The Respondent did not challenge Appellant's submission, that run 5 in Table 1 and run 2 in Table 2, which were undertaken with the used adsorbent from run 4 in Table 1 respectively run 1 in Table 2, illustrated that at some point the metal oxide should be regenerated and that otherwise no adsorption was observed or, even, that sulfur was released instead of adsorbed. Furthermore, Appellant's submissions that runs 3 and 4 of example III illustrated that at the upper temperature limit of the claimed method only a reduced adsorption of sulfur was observed, were not contested.

As the wording of Claim 1 is clearly restricted to a method wherein metal oxides catalyst are used, which are **capable of adsorbing said sulfur species**, the data for run 5 in Table 1 and the data in runs 2, 3 and 4 in Table 2 can only be interpreted that in those experiments use was made of metal oxides not capable of adsorbing sulfur species under the circumstances specified for those runs.

As a matter of principle, the burden of proof is upon the party making an allegation. In the present case, the Respondent did not supply any evidence that methods embraced within the wording of Claim 1 were unable to provide removal of methyl sulfides, ethyl sulfides, propyl sulfides or disulfides. As, thus, the Appellant made an unsubstantiated allegation, which the Respondent contested, the Board does not have any reason to accept such allegation.

Thus, the Board has no reason to doubt that it had been made credible that the problem mentioned in point 2.4.3 was effectively solved by the method of Claim 1.

2.4.6 Therefore, it remains to be decided whether in the light of the teachings of the cited documents a skilled person seeking to solve the problem as defined in point 2.4.3 above would have arrived at the process of Claim 1 in an obvious way or not.

2.4.7 Document (2), which is concerned with the same problem as that underlying the invention, proposes a completely different approach to the problem, namely by adsorbing, absorbing or converting the lower boiling sulfur compounds with, for example zinc oxide, and subsequently eliminating the high boiling sulfur compounds, such as diethyl sulfides, in a distillation zone.

As, thus, document (2) not only proposes the use of a different metal oxide but also the use of a completely different method for removing higher boiling sulfur compounds, namely a distillation instead of an

adsorption, no hint at all to the claimed method can be found in document (2).

- 2.4.8 Document (1) describes a method for removing COS from gas mixtures in which plurally unsaturated compounds, such as propyne and propadiene, are present, which may be formed as byproducts in the thermal cracking of hydrocarbons and which accumulate mainly in the C₃-fraction, by passing the mixtures in liquid phase over e.g. nickel oxide (page 1, lines 42 to 61).

Since, however, document (1) is completely silent about the removal of high boiling sulfurous compounds, such as diethyl sulfide, whereas the claimed method is restricted to the removal of dimethyl sulfides, diethyl sulfides, dipropyl sulfides or disulfides, which are all high boiling sulfurous compounds, the claimed method is also not suggested by the teaching of document (1).

- 2.4.9 Document (5) describes a method of purifying aromatic hydrocarbons containing small amounts of thiophenes, alkylthiophenes and thionaphthenes by contacting the aromatic hydrocarbons with a hydrogenation-dehydrogenation metal catalyst selected from the group consisting of oxides and free metals of e.g. nickel under conditions sufficient to convert the thiophenes, alkylthiophenes and thionaphthenes to metal sulfides and olefins.

Since the teaching of document (5) is restricted to the treatment of aromatic hydrocarbons, without mentioning the treatment of olefinic hydrocarbons, also this document cannot give any hint to the claimed method.

Even more, since it follows from column 6, lines 30 to 34, that it is believed that the metal, **in its free metal state**, combines with the sulfur compounds to eventually form metal sulfides and olefins, document (2) effectively proposes the use of a metal **in its metallic state** and it teaches away from having the sulfur compounds removed by using **metal oxides**.

2.4.10 As the claimed method is thus not obviously derivable from the cited prior art documents, the method of Claim 1, and by the same token, that of dependent claims 2 to 9 meets the requirement of inventive step.

3. *Auxiliary requests*

In the light of the above findings, there is no need to consider the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the claims of the New Main Request submitted at the oral proceedings on 13 January 2005 and a description to be adapted thereto.

The Registrar:

The Chairman:

N. Maslin

A. Nuss