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D E C I S I O N  
of 4 May 1995

Case Number: T 0656/92 - 3.3.1

Application Number: 85201248.3

Publication Number: 0203228

IPC: C10G 65/04

Language of the proceedings: EN

Title of invention:  
Single-stage hydrotreating process

Patentee:  
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Opponent:  
Akzo Nobel N.V.

Headword:  
Hydrotreating/SHELL

Relevant legal provisions:  
EPC Art. 54(2), 56, 84, 106 to 108, 123(2)(3)  
EPC R. 64

Keyword:  
"Admissibility of appeal - yes"  
"Novelty (yes)"  
"Inventive step (yes) - non-obvious alternative"

Decisions cited:  
T 0002/81, T 0213/85

Catchword:  
-



Case Number: T 0656/92 - 3.3.1

DECISION  
of the Technical Board of Appeal 3.3.1  
of 4 May 1995

**Appellant:**  
(Proprietor of the patent) SHELL INTERNATIONALE RESEARCH  
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**Representative:**  
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**Respondent:**  
(Opponent) Akzo Nobel N.V.  
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**Representative:** -

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office dated 7 April 1992, posted  
on 22 May 1992 revoking European patent  
No. 0 203 228 pursuant to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** A. J. Nuss  
**Members:** P. P. Bracke  
W. Moser

## Summary of Facts and Submissions

- I. European patent application No. 85 201 248.3, filed on 29 July 1985, was granted as European patent No. 0 203 228.
- II. The patent was opposed. Revocation of the patent was requested on the grounds of lack of novelty and lack of inventive step.

From the cited prior art documents the following remained relevant during the appeal procedure:

- (1) GB-A-2 073 770.

- III. By a decision issued orally on 7 April 1992, with the reasoned decision being issued on 22 May 1992, the patent was revoked.

The Opposition Division held essentially that the set of claims according to the main request then on file did not meet the requirement of clarity according to article 84 EPC due to the feature "and optionally a few percent of another component" and that for the process claimed according to the auxiliary request then on file an inventive step could not be accepted, because the claimed process was a selection of the process features described in document (1), for which an advantage was not shown.

- IV. The Appellant (Proprietor of the patent) filed a Notice of Appeal on 14 July 1992 and on 20 September 1992 a document headed "STATEMENT OF GROUNDS OF APPEAL".

V. During oral proceedings held on 4 May 1995, the Appellant filed a set of 11 claims headed "main request", with Claim 1 reading:

"1. A process for catalytically hydrotreating hydrocarbon oils at elevated temperature and pressure in the presence of hydrogen in a hydrotreating zone over a stacked-bed of hydrotreating catalysts, characterized in that,

a) oils having a final boiling point greater than 538°C and containing less than 2%w of heptane asphaltenes,

b) oils having a final boiling point from 343°C to 538°C, or

c) mixtures thereof,

are passed downwardly with hydrogen or a hydrogen-containing gas under conditions suitable to convert more than 25% of the sulphur compounds present to hydrogen sulphide at a hydrogen partial pressure of between 6.8 and 75 bar, wherein said stacked-bed comprises an upper zone containing 15-85%v, based on total catalyst, of a hydrotreating catalyst comprising a component from Group VIB of the Periodic Table, a Group VIII metal or metal oxide or metal sulphide and a phosphorus oxide and/or sulphide in an amount of 1 to 10%w calculated basis phosphorus content, and a lower zone containing 15-85%v, based on total catalyst, of a hydrotreating catalyst comprising a component from Group VIB, a Group VIII metal or metal oxide or metal sulphide and less than 0.5%w of phosphorus supported on a carrier consisting essentially of alumina, and separating the reaction product from said hydrotreating zone into a hydrogen-rich gas and a liquid hydrocarbon oil having a reduced heteroatom content."

Claims 2 to 11 were dependent upon Claim 1.

VI. The Appellant submitted that it was the essence of the invention that by using a stacked bed comprising an upper zone catalyst containing phosphorus oxide or sulphide and a lower zone catalyst being substantially phosphorus free, a hydrotreating process could be carried out at low hydrogen partial pressure. Furthermore, he submitted that document (1) was silent about the structure of catalysts to be used in hydrotreating processes at low hydrogen partial pressure.

VII. The Respondent (Opponent) submitted that the appeal was not admissible since the legal and factual reasons why the decision under appeal should be set aside were not stated in the document headed "Statement of Grounds of Appeal".

Additionally, the Respondent argued that the claimed process was not novel over document (1) or was at least directly derivable therefrom, since all the features of the claimed process could be found in that document.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent in suit be maintained based on the main request (Claims 1 to 11, submitted during oral proceedings) or, alternatively, according to the auxiliary request (Claims 1 to 11, filed on 28 April 1995).

The Respondent requested that the appeal be declared inadmissible or be dismissed.

## Reasons for the Decision

### 1. *Admissibility of the appeal*

- 1.1 The appeal complies with Articles 106 and 107 EPC and Rule 64 EPC as well as Article 108 EPC, sentences 1 and 2. Its admissibility therefore depends solely on whether the Statement of Grounds of Appeal, received within four months after the date of notification of the contested decision, contains a "written statement setting out the grounds of appeal" within the meaning of Article 108 EPC, third sentence.

According to the established practice of the Boards of Appeal (see, for example, T 213/85, OJ EPO, 1987, 482), in order to satisfy the criterion of admissibility according to Article 108 EPC, third sentence, the Grounds for an Appeal must state why in the Appellant's view the contested decision cannot be valid or, in other words, the Grounds for an Appeal must state the legal and factual reasons why the decision should be set aside.

- 1.2 In the present case the patent in suit has been revoked because the set of claims according to the then main request did not meet the requirement of clarity and the set of claims according to the then auxiliary request was not inventive over the teaching of document (1).

As a consequence, the Appellant has submitted a Notice of Appeal and, subsequently, a Statement of the Grounds of Appeal having a set of 11 claims headed "Amended set of claims" annexed thereto, requesting in the accompanying letter that the contested decision be set aside and the patent in suit be maintained with that set of claims.

Furthermore, in the Statement of the Grounds of Appeal, the Appellant expounded what he considered to be the gist of the invention (cf. page 1, third and fourth paragraph, in combination with page 3, first paragraph), what was known in the prior art in similar processes (page 1, last paragraph and page 2, first paragraph) and what was, in his view, the difference between the claimed process and the prior art (page 2, second and third paragraph). Additionally, in the last paragraph on page 2 and the first and second paragraphs on page 3 he has analyzed the content of document (1) and specified the difference between the process described therein and that as claimed according to the set of claims annexed to the Statement of Grounds of Appeal, in order to come to the conclusion in the third paragraph of page 3 that the claimed process was neither known nor derivable from document (1).

- 1.3 In this case, although the legal and factual reasons why the decision under appeal should be set aside were not explicitly stated in the document headed "Statement of Grounds of Appeal", it could nevertheless unambiguously be deduced from the content of this statement why, contrary to the findings of the Opposition Division, the claimed process was novel and not directly derivable from document (1) and, consequently, it was implicitly stated why the contested decision should be set aside.

Therefore, the Board finds that the present appeal also complies with Article 108 EPC, third sentence. It ensues that the appeal is admissible.

2. *Main request*

2.1 Amendments

Claim 1 according to the main request differs from Claim 1 as granted by the further features that the hydrotreating process is conducted at a hydrogen partial pressure of between 6.8 and 75 bar, that the upper zone catalyst comprises a phosphorus oxide and/or sulphide in an amount of 1 to 10%w calculated basis phosphorus content and that the lower zone catalyst is supported on a carrier consisting essentially of alumina.

Such further features clearly do not extend the protection conferred by the patent in suit (Art. 123(3) EPC) ..

Additionally, since it was specified in the originally filed application that the hydrogen partial pressure is, in its broadest range, between 6.8 and 75 bar (see Table I on page 12 and page 13, lines 4 to 9), that the upper zone catalyst may contain up to 10%w of phosphorus and preferably at least 1%w of phosphorus, both calculated on the basis of the phosphorus content (see page 8, lines 6 to 8, 19 and 20) and that the carrier supporting the lower zone catalyst consists preferably essentially of alumina (see page 10, lines 11, lines 24, 25 and 29 and page 14, lines 26 to 28), no subject-matter extending beyond the content of the application as originally filed is added (Art. 123(2) EPC).

The same applies to the feature "supported on a carrier consisting essentially of alumina", since it follows from the originally filed application that carriers may contain, in addition to alumina, a few % of other components (see page 14, lines 26 to 28).



More particularly, the combination of the upper limit of the phosphorus content in the upper zone catalyst with a preferred lower limit thereof, both cited in the originally filed application, is not considered to be additional subject matter, which is in accordance with the established practice of the Boards of Appeal (cf. T 2/81, OJ EPO, 1982, 394, item 3).

Claims 2 to 5 and 6 to 11 correspond with originally filed Claims 2 to 5 and originally filed Claims 7 to 12 respectively, with some minor amendments in order to bring these claims in line with present Claim 1, without however adding any new subject-matter.

Consequently, the requirements of Article 123(2) and (3) EPC are met. This has not been contested by the Respondent.

## 2.2 Clarity

The set of claims according to the main request no longer mentions the feature "and optionally a few percent of another component". Therefore, the main ground for revoking the patent in suit, invoked by the Opposition Division with respect to the main request on file in the opposition procedure, is removed.

Since the present set of claims does not contain any unclear features, which assessment has not been contested by the Respondent, the requirement of clarity according to Article 84 EPC is met.

## 2.3 Novelty

In the Respondent's opinion all features of the claimed process were described in document (1), which document was, consequently, to be considered as destroying the

novelty of the claimed process. Nevertheless, the Respondent finally recognised that he was not in a position to indicate in document (1) any basis for considering that the combination of all the process parameters according to Claim 1 was specifically disclosed therein.

In assessing novelty, the content of a document must not be considered as a reservoir from which features pertaining to separate embodiments could be combined in order to create artificially a particular embodiment. In order to be novelty destroying the teaching of a document must be such that a skilled person would seriously contemplate combining the different features cited in that document. This is not the case here, since in document (1) there is no disclosure regarding the use of a stacked-bed containing two hydrotreating catalysts, a first one comprising a phosphorus oxide and/or sulphide in an amount of 1 to 10%w calculated on the basis of the phosphorus and a second one comprising less than 0.5%w of phosphorus supported on a carrier consisting essentially of alumina, at a hydrogen partial pressure between 6.8 and 75 bar, in order to convert more than 25% of the sulphur compounds present in the heavy oils to hydrogen sulphide. Hence, this document cannot be considered to destroy the novelty of the present Claim 1, nor does any other document belonging to the present state of the art.

#### 2.4 *Inventive step*

2.4.1 The Board considers document (1) to be the closest state of the art. This has also been accepted by both Parties.

2.4.2 Document (1) is concerned with the catalytic hydroprocessing of heavy hydrocarbon feedstocks to perform reactions such as hydrodesulfurisation or

hydrocracking (page 1, lines 3 and 10 to 12) by using two catalysts comprising a refractory support and a metal, metal oxide or metal sulphide of a Group VIB or VIII element (page 1, lines 36 to 45).

Furthermore, this document provides a general teaching of process features suitable for carrying out such hydroprocessing, such as,

- the heavy hydrocarbon feedstocks suitable for hydroprocessing (page 1, lines 7 to 10);
- the kind of hydroprocessing reactions, which may be conducted (e.g. hydrodesulfurisation, hydrocracking and the like) (page 1, lines 10 to 14 and 32 to 35, and page 2, lines 3 to 5);
- the kind of catalyst beds that may be used (i.e. fixed beds, fluidized beds and the like) (page 2, lines 50 to 51);
- the hydrogen partial pressure suitable in the hydroprocessing reaction (e.g. 25 to 190 atm, preferably 90 to 160 atm, most preferably 110 to 140 atm) (page 2, lines 9 to 10);
- the kind of refractory support materials that may be used in both catalysts (i.e. alumina, silica, magnesia, zirconia or mixtures thereof) (page 1, lines 55 to 57, and page 2, lines 11 and 12); and
- the promoters that may be used in both catalysts (i.e. phosphorus or titanium as metals, oxides or sulfides) (page 2, line 20).

Additionally, in two examples, the hydroprocessing of heavy hydrocarbon feedstocks over a stacked-bed of two

catalysts, as defined in present Claim 1, under a hydrogen partial atmosphere of 110 respectively 100 atmosphere is described on page 3, line 41 to page 7, line 6.

- 2.4.3 According to the description of the patent in suit, the claimed process has the advantage over the prior art that the catalyst life is increased or allows increased conversion relative to the more traditional catalysts used for the treating of heavy oils (page 2, lines 7 to 9, and page 3, lines 17 to 22).

Additionally, on page 2, lines 31 to 43, it is explained that in prior art processes for hydrotreating/hydrorefining hydrogen-deficient poor quality oils, low catalyst deactivation rates could only be obtained under more stringent hydrorefining unit conditions, such as, higher hydrogen partial pressure, resulting in the use of very expensive hydrotreating equipment. According to the patent in suit the claimed process operates well at hydrogen partial pressures below 75 bar, so that no additional high pressure reactors need to be constructed (page 3, lines 23 to 25).

In order to make it credible that with the claimed process the catalyst life is increased or that an increased conversion is obtained, a comparison is made in Examples 1 to 3, disclosed in the description of the patent in suit, between the performance of a hydrotreating process according to the patent in suit and a corresponding hydrotreating process using only a Ni-Mo-P/alumina catalyst. However, since hydrotreating processes wherein a stacked bed of two catalysts were used have been known from document (1), comparison is not made with the closest state of the art.

Consequently, those comparisons cannot make it credible that the catalyst life is increased or allows increased conversion.

In view of this, the problem to be solved can only be seen in providing a hydrotreating process enabling a refiner to conduct efficient hydrodesulfurisation on heavy oils at such pressures that existing hydrotreating units may be used (page 2, lines 40 to 43).

According to the present Claim 1, this problem is solved by hydrodesulfurising heavy oils at a hydrogen partial pressure of between 6.8 and 75 bar using a stacked-bed of two catalysts as defined in present Claim 1.

Since in Example 2 it has been shown that the sulphur content is reduced, which follows from a comparison of the feed sulphur content (about 3%w), mentioned in Table IV, with the product sulphur content (0.6%w), mentioned in Table V, it has been made credible that the claimed process operates well at hydrogen partial pressures below 75 bar.

- 2.4.4 It remains to be decided, whether, in the light of the teaching of document (1), a skilled person would have chosen the process features according to Claim 1 with a view to convert more than 25% of the sulphur compounds present in oils as defined in Claim 1.
- 2.4.5 The Respondent argued that a skilled person would have done so, because in document (1) not only hydrodesulfurisation reactions have been mentioned as a hydrotreating process, but it also followed from this document that stacked beds of catalysts may be used (the catalysts A/B and A/C in Table 4 on page 5) and that hydrogen partial pressures in the range of 25 to 190 atm were suitable. Moreover, he argued that alumina was

specifically mentioned as support material of the hydrotreating catalysts and phosphorus as promoter. Furthermore, he submitted that the teaching of page 2, lines 36 to 41, that a higher acidity of the lower zone catalyst increased the hydrocracking activity, was a suggestion that, when hydrodesulfurisation is preferred over hydrocracking, the lower zone catalyst should not contain acidic components, such as, silica.

- 2.4.6 It is true that document (1) is concerned with the catalytic hydrotreating of heavy hydrocarbon feedstocks. However, this document, which is predominantly related to the influence of the pore size of catalysts on the hydrotreating performance of such feedstocks (page 1, lines 36 to 47, and page 2, lines 24 to 35), gives rise to a very broad teaching of hydrotreating heavy hydrocarbon feedstocks and, consequently, provides only information of the hydrotreating conditions in general (see item 2.4.2 above), without going into details of the specific conditions required when a specific hydrotreating process, such as a hydrodesulfurisation, is required.

For example, although document (1) mentions the hydrodesulfurisation as one of the possible hydroprocessing processes of heavy hydrocarbon feedstocks (e.g. page 1, lines 10 to 12), it is nowhere suggested which specific catalysts at which hydrogen partial pressure would enable sufficient hydrodesulfurisation of the feedstock.

- 2.4.7 Moreover, the fact that in document (1) alumina and phosphorus are respectively mentioned as suitable support material and promoter of the catalysts may not be regarded as a suggestion to use such specific materials as support material or promoter, because alumina or phosphorus were not cited as the only support

material or promoter, but only as one out of several possible materials. Furthermore, such references cannot be considered to suggest that the upper zone catalysts should contain 1 to 10%w of phosphorus as promoter while the lower zone catalyst should contain less than 0.5%w of phosphorus, or that the lower zone catalyst should be supported on a carrier consisting essentially of alumina.

Also the teaching on page 2, lines 36 to 41, of document (1) may not be regarded as a suggestion that the lower zone catalyst should be supported on a carrier consisting essentially of alumina. The fact that it is mentioned there that, when hydrocracking is desired, the lower zone catalyst should have higher acidity and supports of alumina containing 10 to 70%w silica are exemplified; may not be considered a pointer to use a carrier consisting essentially of alumina, since from such teaching it may not be deduced which kind of support should be used in a hydrodesulfurisation reaction at a relatively low hydrogen partial pressure.

Finally, in neither of the two examples describing hydrotreating processes at hydrogen partial pressures above 100 atm has the sulphur content in the hydrotreated hydrocarbons been mentioned. Consequently, those examples cannot be considered as proposing any process features which bring about efficient hydrodesulfurisation of hydrocarbon feedstock at a low hydrogen partial pressure, namely below 75 bar.

- 2.4.8 Consequently, there is no support for the Respondent's argumentation that, when trying to solve the underlying technical problem, a skilled person would have chosen the process features according to Claim 1 of the patent in suit from all the features mentioned in document (1).

Therefore, the subject-matter of Claim 1 as well as that of Claims 2 to 11, relating to preferred embodiments of the subject-matter according to Claim 1, involves an inventive step within the meaning of Article 56 EPC.

3. *Auxiliary request*

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

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 11 according to the main request, submitted during oral proceedings, and a description to be adapted accordingly.

The Registrar:

The Chairman:

E. Görgmaier

A. Nuss