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**Datasheet for the decision
of 15 October 2007**

Case Number: T 1254/05 - 3.3.06

Application Number: 97906460.7

Publication Number: 0882000

IPC: C07C 5/00

Language of the proceedings: EN

Title of invention:

Hydroisomerization with reduced hydrocracking

Patentee:

ExxonMobil Research and Engineering Company

Opponent:

CHEVRON USA, Inc.

Headword:

Hydroisomerization/EXXON

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (no): all requests"

Decisions cited:

T 0481/99, T 0640/91

Catchword:

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Case Number: T 1254/05 - 3.3.06

D E C I S I O N
of the Technical Board of Appeal 3.3.06
of 15 October 2007

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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
20 July 2005 concerning maintenance of European
patent No. 0882000 in amended form.

Composition of the Board:

Chairman: P.-P. Bracke
Members: G. Dischinger-Höppler
U. Tronser

Summary of Facts and Submissions

I. This appeal is from the interlocutory decision of the Opposition Division concerning maintenance of the European patent No. 0 882 000 in amended form on the basis of the then pending first auxiliary request, the independent Claim 1 reading:

"1. A hydroisomerization process comprising contacting a 176.7°C⁺ (350°F⁺), hydrocarbon containing feed having a final boiling point of less than 566°C (1050°F) in the presence of hydrogen and a catalyst having an acidic functionality in the form of a silica-alumina support containing from 15 to 30 wt% of silica and comprising a cobalt component, a molybdenum component and a hydrocracking suppressant selected from copper and/or sulfur component(s)."

II. A notice of opposition had been filed against the granted patent, wherein the Opponent sought revocation of the patent on the grounds of Article 100(c) EPC for added subject-matter (Article 123(2) EPC) and on the grounds of Article 100(a) EPC for lack of novelty and lack of inventive step (Articles 52(1), 54 and 56 EPC). The opposition was based, amongst others, on the following document

D4 J.P. Franck and J.F. Le Page; "Catalysts for the Hydrocracking of Heavy Gas Oils into Middle Distillates", in Proc. 7th Intern. Congr. Catal. Tokyo, 1981, pages 792 to 803.

Inter alia, the following further document was filed late by the Opponent during the opposition proceedings

D10 H. Pichler et al.; "Über das Hydrokracken gesättigter Kohlenwasserstoffe", Erdöl und Kohle-Erdgas - Petrochemie vereinigt mit Brennstoff-Chemie, Nr. 9, September 1972, pages 494 to 505.

III. In its decision, the Opposition Division held that the subject-matter claimed in accordance with the first auxiliary request fulfilled the requirements of the EPC. The main request was held to be not allowable under Article 123(2) EPC. Late filed documents, inter alia document D10, were not considered prima facie relevant and therefore not admitted into the proceedings.

IV. This decision was appealed by the Opponent, now Appellant.

The Patent Proprietor, now Respondent, maintained the claims held allowable by the Opposition Division as its main request. Under cover of a letter dated 14 September 2007, he filed amended sets of claims in five auxiliary requests (Sets A to E) and announced six further requests as a precaution.

Claim 1 of the first and second auxiliary requests (Sets A and B) are each identical to that of the main request.

Claim 1 of the third auxiliary request (Set C) differs from that of the main request by adding between the terms "hydrocarbon-containing feed" and "having a final boiling point" the feature "obtained from a Fischer-Tropsch process and".

Claim 1 of the fourth auxiliary request (Set D) differs from that of the main request by adding at the very end of the claim the feature ", wherein the feed is a C5⁺ material derived from a non shifting Fischer-Tropsch process".

Claim 1 of the fifth auxiliary request (Set E) differs from that of the fourth auxiliary request by omitting the term "C5⁺".

No hard copies of claim sets for the sixth to eleventh auxiliary requests have been provided. However, it is apparent from the Respondent's statements (letter dated 14 September 2007, page 3) that Claim 1 of the sixth and ninth auxiliary requests are intended to be identical with Claim 1 of the third auxiliary request, Claim 1 of the seventh and tenth auxiliary requests are intended to be identical with Claim 1 of the fourth auxiliary request and Claim 1 of the eighth and eleventh auxiliary requests are intended to be identical with Claim 1 of the fifth auxiliary request.

- V. Oral proceedings were held before the Board on 15 October 2007.

- VI. The Appellant requested admission into the proceedings of late filed document D10 and submitted, orally and in writing, in essence the following arguments:
 - The amendments made to the claims were not allowable under the provisions of Articles 84 and/or 123(2) EPC.

- The claimed subject-matter was not novel over the cited prior art.

- The claimed subject-matter was not inventive over the prior art disclosed in document D4 alone or over that of document D10 in combination with the disclosure of document D4 as far as the sulphur embodiment was concerned. This was due to the fact that this particular embodiment differed from the prior art disclosed in documents D4 or D10 only in that the amount of silica contained in the silica/alumina support of the bifunctional cobalt/molybdenum (Co/Mo) catalyst used in the claimed process was lower, namely 15 to 30 wt% versus 70 or 85 wt% and that no evidence was on file showing that a particular effect was obtained by this distinguishing feature. Considering the teaching of document D4, it was, however, obvious for a skilled person to use a bifunctional Co/Mo catalyst containing less silica in the support for hydroisomerising n-paraffins.

VII. The Respondent, orally and in writing, refuted the Appellant's objections and requested not to admit the late filed evidence. It submitted in essence that the amendments made to the claims were allowable under Article 84 and 123(2) EPC and that the claimed subject-matter was novel in view of the cited prior art.

Concerning inventive step, it was submitted that the examples of the patent in suit showed an unexpected increase of the yield of isomerised products and decrease of methane production for a commercial Co/Mo catalyst on a silica/alumina support containing 20 to

30 wt% of silica if the catalyst was sulfided. The teaching of document D10 was opposite to the results obtained in the examples of the patent in suit since it consisted in the finding that sulfurisation of the catalyst greatly reduced the isomerisation turnover. Document D4 disclosed a beneficial effect only in regard of a Ni/Mo catalyst which was not comparable with the Co/Mo catalyst used in the claimed process and did not give any hint that reduction to 15 to 30 wt% of the silica content in the carrier of the Co/Mo catalyst disclosed in documents D4 or D10 would give the beneficial effect found in the examples of the patent in suit. Therefore, the claimed subject-matter was not rendered obvious by the cited prior art.

VIII. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested that the appeal be dismissed or the decision under appeal be set aside and the patent be maintained on the basis of one of the auxiliary request 1 to 11 submitted under cover of the letter dated 14 September 2007.

Reasons for the Decision

1. *Amendments and novelty*

The question of whether the amendments made to the claims of all requests are admissible under Articles 123(2) and 84 EPC or whether the claimed subject-matter is novel in view of the cited prior art (Article 54 EPC) need not be gone into since,

eventually, the appeal succeeds for the reason of lack of inventive step.

2. *Inventive Step - Main Request*

2.1 The patent in suit and in particular Claim 1 relate to a hydroisomerisation process of a 176.7°C hydrocarbon feed having a final boiling point of less than 566°C over a catalyst containing Co and Mo and, as a hydrocracking suppressant, copper and/or sulphur on a silica/alumina support containing 15 to 30 wt% of silica (page 2, paragraph [0001] and page 3, paragraphs [0009], [0015] and [0019]).

It is explained in the description of the patent in suit that hydroisomerisation catalysts are rapidly poisoned by sulphur compounds. Thus, isomerisation processes in the presence of hydrogen are effected with unsulfided catalysts. However, as a consequence, hydrogenolysis such as hydrocracking occurs early in the processing which produces significant amounts of gases such as methane (page 2, paragraphs [0002] and [0003]).

Hence, the technical problem the patent in suit seeks to solve by the claimed subject-matter consists in the provision of a process which can reduce hydrogenolysis, in particular methane production, and increase yields of the desired isomerised products (page 2, paragraph [0003] and page 3, paragraph [0010]).

2.2 The Appellant relied on document D4 or, alternatively on document D10 as the closest prior art.

Both documents are scientific articles about the influence of differently composed bifunctional catalysts on hydrocracking, especially on the ratio of yields due to hydrogenolysis versus yields due to hydroisomerisation, illustrated on model n-paraffins such as heptane or hexadecane (D4, page 792, abstract and fourth paragraph, page 793, point 3.1 to page 794, line 2; D10, page 494, Übersicht and pages 495 to 496, "Ergebnisse und Diskussion, Umsatz von Paraffinen durch Spaltung und Primärisomerisierung an verschiedenen bifunktionellen Katalysatoren beim Hydrokracken").

However, in contrast to document D10 which teaches that sulfurisation of a Co-Mo-Al₂O₃-SiO₂-catalyst decreases formation of methane (see page 501, right-hand column, "Einfluß einer Katalysatorschwefelung: Spaltung von n-Hexadecan am Co-Mo-Al₂O₃-SiO₂-Katalysator" and page 505, Table 8 and left-hand column, second full paragraph), document D4 does not include any research into suppression of methane production, but considers as gaseous products propanes and butanes only (D4, page 793, Figure 1 and page 795, last paragraph to page 796, first paragraph).

- 2.3 The Board is, therefore and contrary to the Opposition Division, of the opinion that document D10 is more relevant than document D4 and, thus, the most suitable starting point for the assessment of inventive step of the claimed subject-matter. Therefore, and in accordance with the decisions of the Boards of Appeal T 481/99 (not published in the OJ EPO, reasons No. 5.2) and T 640/91 (OJ EPO, 1994, 918, headnote III), both cited by the Respondent, the Board exercises its discretion to admit document D10 into the proceedings.

2.4 In the study of document D10, several catalysts are compared with respect to their performance in hydrogenolysis and hydroisomerisation of n-paraffins as model feed. One of these catalysts differs from that used according to the process of Claim 1 only insofar as it contains 85 wt% of silica in the support. It is indicated as Co-Mo-Al₂O₃-SiO₂-S. Other catalysts differ therefrom only in that they are not sulfided and/or free of silica. These catalysts are indicated as Co-Mo-Al₂O₃-SiO₂, Co-Mo-Al₂O₃-S and Co-Mo-Al₂O₃. One model feed is n-hexadecane, a feed within the definition of Claim 1 (D10, page 495, left-hand column, first paragraph to right-hand column, line 3 and page 496, left-hand column, lines 5 to 8).

Hence, the process of Claim 1 differs from the application disclosed in document D10 of the sulfided Co-Mo-Al₂O₃-SiO₂-S-catalyst on hexadecane only in that the catalyst contains less, namely 15 to 30 wt%, of silica.

2.5 It is undisputed that no evidence is on file showing by comparison that the claimed catalyst containing 15 to 30 wt% of silica produces more isomerised products and less methane than the more acid catalyst (85 wt% of silica) disclosed in document D10.

2.6 It is shown in document D10 that up to a reaction temperature of about 420°C cleavage conversion (i.e. crack conversion) is scarcely influenced by the sulfurisation of the Co-Mo-Al₂O₃-SiO₂-catalyst whereas isomerisation turnover is greatly reduced (page 495,

Figure 2 and page 496, left-hand column, fifth paragraph).

In contrast to this finding, so the Respondent argued, it was apparent from the examples of the patent in suit that the opposite result was obtained with the claimed process which was carried out on a sulfided Co/Mo-catalyst containing only 15 to 30 wt% of silica in the $\text{Al}_2\text{O}_3/\text{SiO}_2$ support, namely a considerable increase of the yield of isomerised products and a considerable decrease of cracked products, in particular of methane, when compared with the corresponding non-sulfided catalyst.

The Respondent did not dispute that n-heptane which was used as a model feed in the examples of the patent in suit is not a feed according to the requirements of Claim 1. However, the Respondent was of the opinion that the same results would be obtained with higher n-paraffins as feed, thus also for n-hexadecane.

Therefore, the technical problem indicated in the patent in suit (point 2.1 above) had been solved by the claimed subject-matter in view of the disclosure of document D10.

2.7 The Board does not agree with the Respondent that the examples of the patent in suit are valid evidence for a beneficial effect of the claimed subject-matter over the disclosure of D10.

2.7.1 Firstly, it is known from document D10 that - irrespective of the type of the bifunctional catalyst - isomerisation conversion increases up to a maximum with

temperature and then decreases since the isomerised products are increasingly cloven (or cracked) at higher temperatures. Further, it is shown that cleavage (or cracking) conversion at first increases exponentially with the temperature and then tends towards the value of 100% (page 496, left-hand column, second paragraph).

Secondly, it is known that different catalysts have different activities in relation to cleavage and isomerisation. This means, on the one hand, that different conversions are obtained with different catalysts at a given temperature and, on the other hand, that the ratio isomerisation yield to cleavage yield varies largely with the temperature for a given catalyst (D10, page 495, Figure 2 and page 496, left-hand column, third paragraph).

Further, it is known from document D10 that the isomerisation and cleavage conversions also depend on the carbon number of the paraffinic feed. Thus, it is shown in document D10 that for a given catalyst and at a given temperature the conversions, in particular the cleavage conversion, are considerably lower for n-octane than for n-hexadecane even though in the latter case the space velocity was twice as high as in the first case (page 497, left hand column, Table 3 and first to third paragraphs). As is shown in Table 3 of document D10, this leads to quite different ratios of yields due to isomerisation versus yields due to cleavage.

The Board concludes, therefore, that it depends not only on the particular catalyst but also on the

paraffinic feed and on the process temperature whether the paraffins are preferably cloven or isomerised.

- 2.7.2 It is apparent from the examples in the patent in suit that the non-sulfided catalyst is more active with respect to the cracking of n-heptane than the sulfided catalyst since the run with non-sulfided catalyst results in a much higher cracking conversion (32.3 wt%) than the run with the sulfided catalyst (5.7 wt%) even though the process conditions selected in the examples are the same for both catalysts. However, it follows from the above teaching of document D10 (point 2.7.1) that an increased cleavage of the isomerised products of n-heptane occurs more easily with the more active non-sulfided catalyst when compared with the sulfided catalyst.

The extent of cleavage and isomerisation is, therefore, also influenced by the cracking conversion at particular process conditions.

Therefore, no conclusions can be drawn from the examples given in the patent in suit concerning the influence of sulfurisation of the catalyst on cleavage and isomerisation without neglecting the known effect produced thereon by the different cracking conversions.

Further, it is apparent that n-heptane, a rather short chain paraffin having a boiling point of about 98°C, is a feed far outside the requirements of Claim 1 (boiling point of at least 176.7°C). Given the effect provided by the carbon number of the n-paraffin on cleavage and isomerisation conversion which is known from document D10 (point 2.7.1 above), the results obtained in the

patent in suit with n-heptane are thus not comparable with the results obtained in document D10 with n-hexadecane.

- 2.7.3 The Board concludes, therefore, that no evidence is on file showing that the above stated technical problem, namely to provide a process which can reduce hydrogenolysis, in particular methane production, and increase the yield of the desired isomerised products (point 2.1 above), has been solved by the features distinguishing the claimed subject-matter from the disclosure of document D10 (point 2.4 above).

The Board agrees therefore with the Appellant that the technical problem credibly solved by the claimed subject-matter over the disclosure of document D10 can only be seen as providing another hydroisomerisation process at low methane production.

- 2.8 It remains to be decided whether, in view of the available prior art documents, it was obvious for someone skilled in the art to solve the above stated, less ambitious technical problem by the means claimed, namely by using in the process a less acid catalyst, namely one containing only 15 to 30 wt% of silica as defined in Claim 1 instead of one containing 85 wt% as disclosed in document D10.

- 2.9 Document D10 does not contain any information about catalysts having a silica content between 0 wt% (Co-Mo-Al₂O₃-S- and Co-Mo-Al₂O₃-catalysts) and 85 wt% (Co-Mo-Al₂O₃-SiO₂-S- and Co-Mo-Al₂O₃-SiO₂-catalysts).

It is, however, known that the silica content, i.e. the acidity of the catalyst, has an influence on the extent of cracking and isomerisation of n-paraffins. Thus, it is shown in document D4 that cracking conversion increases and selectivity towards hydroisomerisation decreases with increasing acidity (or silica content) of the catalyst (page 798, first full paragraph in combination with page 799, first full paragraph). The fact that this effect is shown particularly for a Ni/Mo-catalyst applied on n-heptane is irrelevant in the present case since Co/Mo-catalysts on an Al₂O₃/SiO₂-support containing silica in the claimed range (20 to 30 wt%) were known and commercially available at the priority date of the patent in suit (Example 1 of the priority document) and nothing in the prior art suggests that this catalyst would be unsuitable for hydroisomerisation of n-paraffins.

2.10 The Board concludes, therefore, that using a catalyst of less acidity, such as the commercially available catalyst, is one option which a skilled person would consider in the expectation to provide another hydroisomerisation process than that disclosed in document D10. Further, he would apply this catalyst in the sulfided form in order to suppress methane production as taught in document D10.

2.11 For these reasons, the Board finds that the subject-matter of Claim 1 of the main request is not based on an inventive step and does not comply with the requirements of Articles 52 (1) and 56 EPC.

3. *Auxiliary requests*

3.1 The same reasoning applies to the subject-matter of Claim 1 of the first and second auxiliary requests since these claims are identical with Claim 1 of the main request (point IV above).

3.2 Claim 1 of the third, fourth and fifth auxiliary requests differ from that of the main request only in that the hydrocarbon containing feed is further specified to be "obtained from a Fischer-Tropsch process", or "a C5⁺ material derived from a non shifting Fischer-Tropsch process" or "a material derived from a non shifting Fischer-Tropsch process".

The Respondent did not provide arguments as to why and how these newly added features might include subject-matter on which an inventive step could be based in view of document D10. In particular, it was not denied that n-hexadecane can be obtained or derived from a (non-shifting) Fischer-Tropsch process. Thus, Claim 1 of the third to fifth auxiliary requests still covers n-hexadecane as the feed. However, the Respondent did not give any reasons why the particular source of the feed should change the situation of the case.

Therefore, the Board has no reason to assume that an inventive step could be based on the newly introduced features. Given these circumstances, the Board has no choice but to conclude that those features merely relate to options well-known in the art which a skilled person would consider for providing a n-hexadecane feed suitable in the hydroisomerisation process disclosed in D10.

Consequently, the reasoning given with respect to Claim 1 of the main request applies mutatis mutandis to Claim 1 of any of the third to fifth auxiliary requests.

- 3.3 The Board has strong reservations as to the admissibility of the sixth to eleventh auxiliary requests since the Respondent has not filed any hard copies of the respective claim sets.

This is, however, irrelevant in the present case since the respective Claim 1 of the sixth to eleventh auxiliary requests is identical with that of the third, fourth or fifth auxiliary requests (point IV above) so that it is prima facie evident that, for the same reasons as given above for the third to fifth auxiliary requests, none of those requests can succeed.

4. Since all of the Respondent's requests fail, the patent has to be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

G. Rauh

P.-P. Bracke